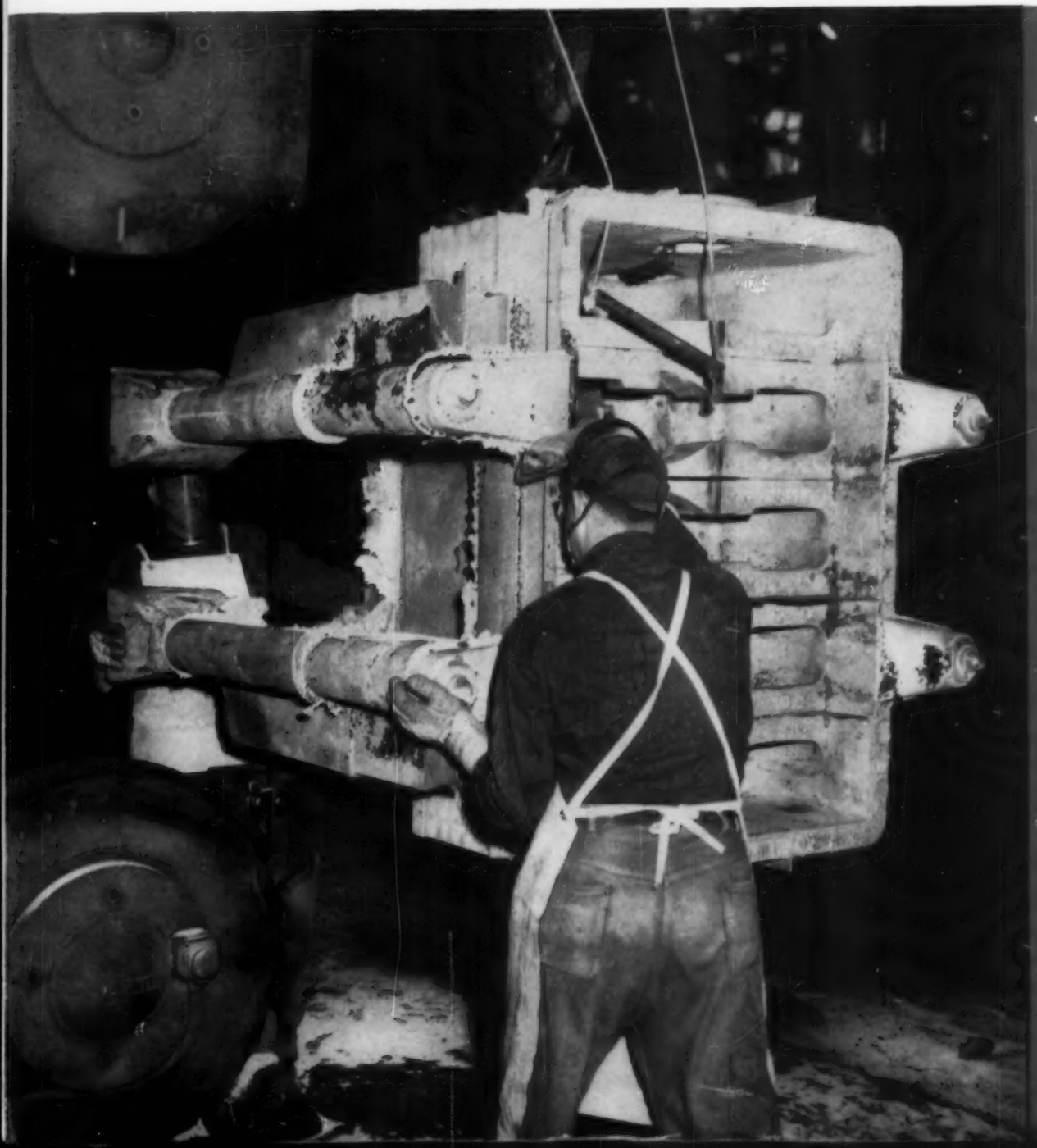
JULY, 1955

modern castings

and American Foundryman



Owned by THE MEN WHO BUY

How to Bake Cores Without Heat 32

Carbon dioxide blown through a sand-water glass mixture will bond them in minutes.

Human Relations in the Foundry 36

Forces are working for a protest-and-pressure type of employee and management relationship.

Casting High Quality Magnesium 38

A new look at every phase of production and testing for better magnesium foundry practice.

Does Your Insurance Cover It? 45

A $12,000 heat treat accident turned this company's thoughts to adequate coverage.

Smooth that Alligator Skin! 80

Researchers found that a little bit of sand additive is good—but too much is too much.

Is Oil Quenching Best for Pearlitic? 85

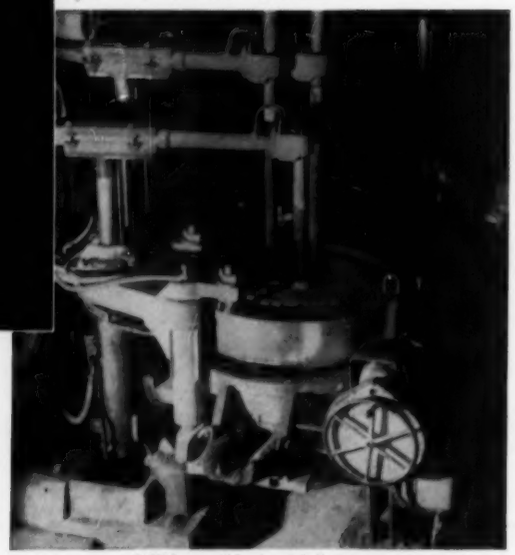
Tests show higher yield strength and elongation when oil quenched than when air-cooled.

Special Bonus Section

ENVIRONMENT IN THE FOUNDRY

32 pages of ideas for controlling working conditions to make the foundry a good place to work.

3,000-pound Lectromelt Furnace



1,000-pound Lectromelt Furnace

500-pound Lectromelt Furnace

We like the FLEXIBILITY provided by our 3 Lectromelt furnaces

SAY ELECTRO-ALLOYS DIVISION, AMERICAN BRAKE SHOE COMPANY, ELYRIA, OHIO

Electro-Alloys can make quick shifts in alloys melted and weight of metal cast, thanks to the flexibility offered by these three Lectromelt* Furnaces. By keeping the small furnace on Ni-Resist exclusively, they avoid the need for wash heats and assure integrity of the alloy.

They cast a great many different alloys, and the castings range in weight all the way from a few ounces to 13,000 lbs., calling upon the additional capacity of other furnaces.

Precise control of melting conditions is inherent in Lectromelt equipment. Whether you're working with iron, plain carbon or alloy steels, a Lectromelt Furnace will give you this advantage.

Lectromelt engineers will answer your questions and supply you with catalog data on Lectromelt Furnaces—25 lbs. to 150 tons. For Catalog No. 9, write Pittsburgh Lectromelt Furnace Corporation, 316 32nd Street, Pittsburgh 30, Pa.

Manufactured in...GERMANY: Friedrich Kocks GMBH, Dusseldorf...ENGLAND: Birlec, Ltd., Birmingham ... FRANCE: Stein et Roubaix, Paris... BELGIUM: S. A. Belge Stein et Roubaix, Bressoux-Liege ... SPAIN: General Electrica Espanola, Bilbao ... ITALY: Forni Stein, Genoa. JAPAN: Daido Steel Co., Ltd., Nagoya

*REG. T. M. U. S. PAT. OFF.

MOORE RAPID

WHEN YOU MELT... *Lectromelt*

For more facts, circle No. 75 on postage-free Reader Service card on p. 103 or 104

future meetings and exhibits

SEPTEMBER

1-15 . . Engineering, Marine and Welding Exhibition and Foundry Trades Exhibition, Olympia, London, England.

12-16 . . Instrument Society of America, Shrine Exposition Hall, Los Angeles. 10th Annual Conference and Exhibit.

20-22 . . Tenth Annual Industrial Packaging & Materials Handling Exposition, Kingsbridge Armory, New York. Sponsored by Society of Industrial Packaging & Materials Handling Engineers.

29-30 . . Missouri Valley Regional Conference, Missouri School of Mines, Rolla. Sponsored by the St. Louis, Mo-Kan and Tri-State Chapters of AFS, in cooperation with Missouri School of Mines.

OCTOBER

6-7 . . National Foundry Association, Edgewater Beach Hotel, Chicago. Fifty-seventh Annual Meeting.

13-15 . . Foundry Equipment Manufacturers Association, The Greenbrier, White Sulphur Springs, W. Va. Annual Meeting.

16-18 . . Conveyor Equipment Manufacturers Association, The Greenbrier, White Sulphur Springs, W. Va. Annual Meeting.

17-21 . . National Safety Congress and Exposition. Chicago, Ill. Forty-third Annual Congress.

17-21 . . American Society for Metals, Convention Hall, Philadelphia. National Exposition and Congress.

19-21 . . Gray Iron Founders' Society, Hotel Schroeder, Milwaukee. Twenty-seventh Annual Meeting.

20-21 . . Ohio Regional Foundry Conference, Case Institute of Technology, Cleveland. Sponsored by the Northeastern Ohio, Toledo, Canton District, Central Ohio, and Cincinnati District Chapters of AFS in cooperation with Case Institute of Technology.

24-25 . . Steel Founders' Society of America, The Greenbrier, White Sulphur Springs, West Virginia. Fall Meeting.

NOVEMBER

3-4 . . Metals Casting Conference, Purdue University, West Lafayette, Ind. Sponsored by the Central Indiana and Michiana Chapter of AFS in cooperation with Purdue University.

14-17 . . International Automation Exposition, Navy Pier, Chicago.

School of Mines Site of Missouri Valley Regional

The campus of the University of Missouri School of Mines and Metallurgy at Rolla will be the site of the Missouri Valley Regional Foundry Conference on Thursday and Friday, Sept. 29-30.

Sponsored by the following American Foundrymen's Society chapters: St. Louis, Mo-Kan (Kansas City), Tri-State (Tulsa), and the M.S.M. Student Chapter, the conference is under the general chairmanship of Webb L. Kammerer, Midvale Mining & Mfg. Co., St. Louis. Honorary chairman is Curtis L. Wilson, dean of M.S.M.

The general conference committee includes Albert W. Schlechten and Daniel S. Eppelsheimer, M.S.M., and Erhard Neuman, M.S.M. student; Henry C. Deterding, Sonken Galamba Corp., and Lloyd Canfield, Canfield Foundry Supplies & Equip., both of Kansas City, Kans., chairman and past chairman, respectively, Mo-Kan chapter; Willis H. Mook, Bethlehem Supply Co., and Donald W. McArthur, Oklahoma Steel Castings, Inc., both Tulsa, Okla., Tri-State chairman and past chairman; George L. Mitsch, A.C.F. Industries, Inc., and Fredrick J. Boeneker, Bronze Alloys Co., both St. Louis, chairman and past chairman St. Louis chapter.

In addition the committee includes AFS past national directors J. T. Westwood, Jr., Blue Valley Foundry Co., Kansas City, Mo.; C. R. Culling, Carondelet Foundry Co., St. Louis; and Albert L. Hunt, National Bearing Div., American Brake Shoe Co., St. Louis.

Theme of the conference, "Some-

FEDERAL **GREEN BOND** . . . THE **PURE** BENTONITE

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Back in 1925, bentonite was *first* developed, by FEDERAL, as an admix to molding and core sands. FEDERAL GREEN BOND was introduced at that time as *pure* bentonite of the highest quality, specially processed for foundry use. It's been just that ever since—unadulterated, untreated, free of chemicals or other ingredients detrimental to foundry sands or conditions. There are other reasons, too, for its superiority as a sand additive, such as:

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Here's an essential point to remember, when selecting your source for bentonite . . . FEDERAL GREEN BOND is sold and serviced by FEDERAL's own trained, technical service engineers! FEDERAL's interest in your use of its products doesn't stop at the time of sale, but continues beyond, in the form of technical service and assistance.

FEDERAL *guarantees* that GREEN BOND will produce the *highest* green and dry bond strength of any of the western bentonites.

FEDERAL GREEN BOND's medium to low gelatinating characteristics cut down on mulling time—permit slurry users to add up to 25% more bentonite per gallon of slurry, without strain on the pumping system.

FEDERAL GREEN BOND has a pH value of 9.0

FEDERAL GREEN BOND lasts and lasts—retaining its bonding efficiency much longer than any other bonding agent.

FEDERAL GREEN BOND induces exceptionally high permeability, permitting the use of fine sands for better casting finish.

FEDERAL GREEN BOND contributes materially to the production of castings that are free of defects—castings that require much less cleaning—castings that look good and bring higher prices.

FEDERAL controls every phase of the production of GREEN BOND, from mining and processing to sales and technical service.

FEDERAL GREEN BOND is carried in stock in FEDERAL warehouses in principal cities in the U. S., Canada, British Isles and Continental Europe. It is available in *three* convenient forms: (1) PULVERIZED—for general foundry use as a dry additive, for core and molding sand. (2) GB-100 FINE GRANULAR—a dry additive with low dust content, for core and molding sand. (3) No. 1200 SLURRY GRADE GRANULAR—for use as a wet additive.

Next time you buy bentonite—try FEDERAL GREEN BOND! You'll soon learn why it's known everywhere as the "BEST OF THE BENTONITES!".

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ONE-MAN POURING, This Easy Way—

MODERNIZED pouring, directly into the nonferrous molds from graphite crucibles, saves backs and bucks too! It's a safe, winning combination "straight-thru" from monorail track to crucible spout:

- Trolleys are designed for the safe, fast movement of molten metal . . .
- Anti-friction-bearing, swiveling hook-eye permits smooth, easy turning for right and left spotting . . .
- Steel, cut-tooth machined rack is rigidly supported by machine-turned rollers in the side arms. No sway! No spill!
- Bail with quick-detachable hooks safely grip the trunnions . . .
- Tilting action is transmitted from hand-shank through machined-ring which fits contour of the crucible. Raised trunnions lend proper support and balance . . .

MODERN — the original pouring device affords rigid, straight-line, positive control from monorail to crucible spout.

FOR OTHER FACTS AND COST FIGURES ASK FOR CATALOG P-152:

50 PAGES OF POURING FACTS

Catalog P-152 illustrates construction features and production facts on MODERN pouring devices, crucibles, ladles, cranes and monorail systems. Eighteen types of ladles, as grouped by series numbers, diameters and metal capacities, match-up metal loads with gross lifting capacities.

MODERN

NEW
Catalog P-152
mailed on request

thing for Everyone," is evidenced in the following schedule:

THURSDAY, SEPTEMBER 29

9:00 am.....Registration Opens
10:15 am.....Conference Opening
10:30 am.....Joint Session *"New Horizons in Foundry Progress"*
2:00 pm.....Joint Session *"Can Shell Cores Help You?"*
3:30 pm...Simultaneous Sessions: Gray Iron, Non-Ferrous, Steel

FRIDAY, SEPTEMBER 30

9:30 am.....Joint Session *"Practical Modernization for Small Foundries"*
10:30 am...Simultaneous Sessions: Gray Iron, Non-Ferrous, Steel

An Ozark Hillbilly Jamboree planned for Thursday evening at the Forest Springs Lodge will include a barbeque. A special program of entertainment is scheduled for ladies attending the conference; there will be no ladies registration fee.

Adequate housing is available and will be allocated through a central housing bureau in the near future. For further details and advance registration applications write to: Missouri Valley Regional Conference, c/o Midvale Mining & Mfg. Co., 5015 Manchester Ave., St. Louis 10, Mo.

List Films on Grinding

What you should know about grinding is available in a series of 16-mm, color-sound motion pictures available to schools, industrial societies, and wherever shop practice is taught.

"The Grinding Wheel, Its Care and Use" gives detailed instruction in the handling, storage, and use of grinding wheels. "Grinding Wheel Markings" explains each symbol on the wheel through laboratory and shop demonstrations. "Grinding Wheel Safety" emphasizes the more important causes of grinding wheel breakage. "Grits that Grind — A Story of Modern Abrasives" shows the manufacture of grinding wheels from bauxite mines to finished wheels. "Offhand Grinding with Norton Abrasives" presents operations of removing risers, gates, and pads from steel castings, swing frame and portable machine operations, and other rough grinding jobs.

For film write to Norton Co., Publicity Dept., Worcester 6, Mass.

july 1955
vol. 28 No. 1

modern castings

and American Foundryman

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AUDITED PAID CIRCULATION ABC

TIPS, TRENDS AND TECHNIQUES

Cover shows one way to remove complex gating systems and large risers used on magnesium castings. "Casting High Quality Magnesium" (page 38) brings magnesium founding up to date.

Bake cores without heat? Everybody's blowing carbon dioxide through sand mixtures these days. One fellow who doesn't have a shop to play in carries a CO_2 rig and some waterglass in his car so he can experiment whenever he visits a foundry. If you want to try it, start reading on page 32.

Human relations are as important in the castings industry as anywhere. Views of one representative of top management are told on page 36.

Environment in the foundry is such a significant phase of human relations the American Foundrymen's Society is publishing a book about it. A 32-page condensation of the story, full of ideas that make the foundry a **good** place to work, is this month's bonus for our readers.

How's your insurance? Check list of foundry coverage (page 45) gives you something to compare your program with.

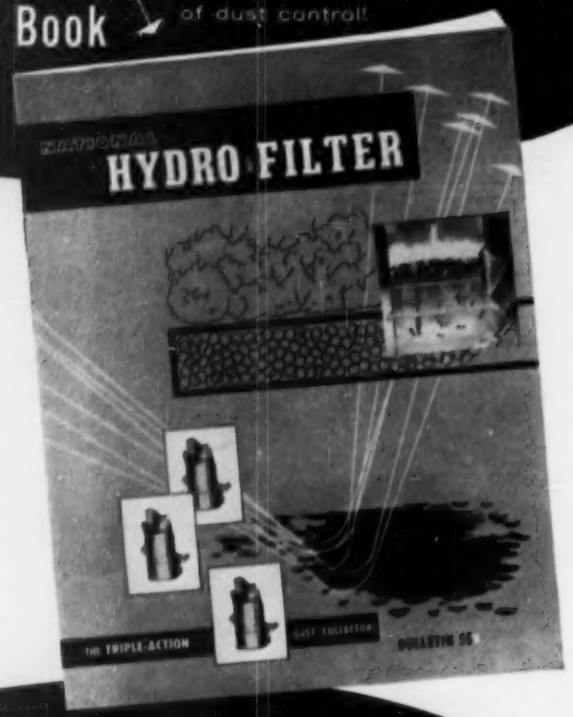
Alligator skin may not trouble you, but it made one foundryman phone for a preview of the story on page 80 after learning this issue would show why a little sand additive is good—but too much is too much!

Pearlitic can be oil quenched or air cooled. Read how one foundry gets higher yield and elongation on page 85.

Let's look at August. Next month, "They're Making Molds Out of Glass Now" and "Corn Sugar Makes Sweet Core Binder." . . "Why Use Forged Hooks?" is the tale of the manufacturer who switched to cast steel . . . "No Chain Failures in This Foundry," a complete program for procurement, inspection, and maintenance of chains and slings. . . "What's New in Aluminum Bronzes" . . . "Let's Make Basic Steel" answers puzzling melting questions. . . For investment casters, a story on carbon control. . . And there's "The Case of the Absorbed Oxygen."

We didn't forget the bonus section that gives MODERN CASTINGS more feature technical material on foundry practice than any metal working publication. In August, "Molding Materials, Methods, and Machines."

Here is the Book that describes an entirely new concept of dust control!



Here is the Collector . . .

that takes advantage of the most effective dust control principle known to man—that of simple filtration. In so doing it will promise three advantages, sought for wherever dust control or maintenance of wet type dust collectors is a problem:

EASE OF MAINTENANCE No moving parts to corrode.

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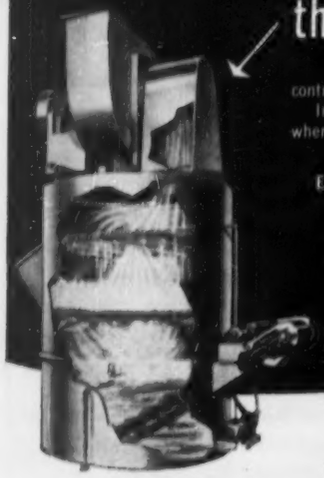
EXTREME SIMPLICITY makes it a tool that is easy to understand, operate and maintain.



WRITE FOR BULLETIN 55 today!

Details on operating principle, the 14 (500 to 25,000 cfm) models available and a record of test results with the Hydro-Filter are included.

NATIONAL HYDRO-FILTER

Dust Collector Corp.

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Subsidiary of National Engineering Company, Manufacturer of Simpson Mix-Mullers.

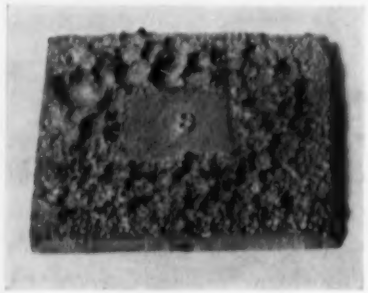
For more facts, circle No. 78 on postage-free Reader Service card on p. 103 or 104

pouring off the heat

Makes 'em Rough

■ Enclosed is our solution in magnesium to the problem of how to make rough castings like the one shown on page 81 of the March issue of AMERICAN FOUNDRYMAN.

Drag side of pattern was covered with clay balls. (More uniformity can be achieved by careful riddling or by using shot.) Sand was rammed up to hold balls in place. Up to here a protective block was in place over the lettering. Block was removed,



sand riddled, and rest of drag rammed full. Flask was rolled over. Cope was rammed up, removed, and pattern drawn. Same block was placed over lettering in drag. Clay balls were sprayed with molasses, graphite was dusted on, then blown off. Spray, graphite, and blow were repeated to achieve desired build up. Drag was dried, cope replaced, mold was poured.

"Taint pretty nor practical.

BEN H. SCARBURY
John Hastie Co.
Glendora, Calif.

'Taint the way the plaque in the AFS Technical Center was made but we have to admit your method works too. For the full story on how to avoid as well as create an alligator skin on castings see Burdette Jones' story starting on page 80, this issue.—Editor.

New High-Temperature Alloy

■ Your April "Talk of the Industry" description of Thermenol is most provocative. Please let me know whom to contact for further information.

GERALD J. GROTT
Sapulpa, Okla.

■ In your "Talk of the Industry" column in April you mentioned Thermenol. Is it being produced solely for test purposes or is it in commercial production?

RALPH A. WALSH
Investment Casting Co.
Springfield, N. J.

■ Can you furnish any further information on Thermenol other than that on your "Talk of the Industry" page in the April issue?

NEIL M. WATERBURY
General Engineering Dept.
Owens-Illinois Tech. Center
Toledo, Ohio

Thermenol, a new light-weight, high-strength, heat and oxidation resistant alloy developed by the Navy's White Oak Ordnance Laboratory, is described in "Thermenol—A Non-Strategic Aluminum-Iron Base Alloy for High Temperature Service." Order PB111530 from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. Send 50c; make check or money order payable to Office of Technical Services.—Editor.

Misused Talent

■ From time to time, various technical and engineering magazines have published reports concerning

the critical shortage of engineering graduates in this country. The general opinion is that with the shortage, every attempt must be made to utilize them to their fullest advantage. Accordingly, it would seem that when engineering graduates are drafted, they should be utilized as engineers while in service.

This would benefit all concerned. Not only would the engineer be of more service to the army as an engineer, but with two years of experience gained, he would be considerably more valuable to industry upon release.

In 1950, the Engineering Manpower Commission was established to insure the proper utilization of engineers in service. Unfortunately, since then the program has collapsed. Today, engineers like myself are drafted, assigned to miscellaneous tasks, and forgotten for two years.

In reply to a letter of protest I filed with the Adjutant General, it was explained that "because of the present excess of mechanical engineers in the army, I can be best utilized in my present position." What my present position is, or what it should be, no one seems quite sure. My situation is by no means isolated. In this one company alone, there are several aeronautical, electronics, industrial, and mechanical engineers.

PVT. MERTON L. BARTSCH

Pvt. Bartsch, who has spent 13 months sweeping streets and handling a shovel, was recently declared "excess personnel" and was assigned to a permanent "painting detail." A condensation of his investigation of the thermal conductivity of nodular and several other irons, research which helped him earn a master's degree at the University of Minnesota, will appear soon in Modern Castings.—Editor.

Tear Sheets Gladly Sent

■ I would like two copies of *"Calculations of Horizontal Gating Systems"* by John G. Kura, which appeared on the "Foundry Facts" pages of the May issue of AMERICAN FOUNDRYMAN.

I will pass one copy on to the rigging clerk of our plant.

L. E. HOLM, *Clerk*
Standards Dept.

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MAXIMUM PRODUCTION! . . . . . at minimum costs

***37,440 pin cores per shift!**

If you need pin cores . . . lots of 'em . . . and every one perfect . . . this is the machine for you.

Tolerances held to within .005 of an inch and produced at less than $1 for 600 . . . all costs included.

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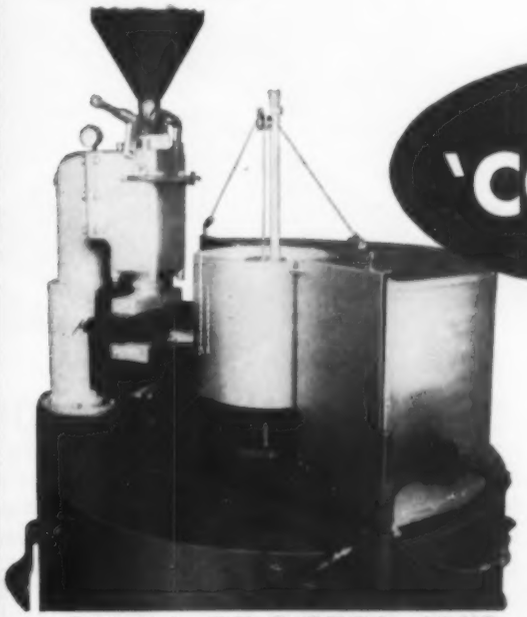
****1/3 the cost of old methods**

The Core Chief produces even the most intricate shell cores completely cured . . . ready to use . . . without wires, vents or dryers.

You get smooth precise inside finishes . . . better collapsibility for speedier shakeout.

By eliminating core dryers and ovens . . . using unskilled labor the Core Chief produces better cores . . . at speeds hitherto impossible . . . and at savings of 50% or more.



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For 10-lb.-pig users, this new ingot means no free-carbon pockets, finer grain structure, more even melting. Available in all grades, silvery and HannaTite—an extra-close-grain iron.

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■ Kindy send two copies of the "Foundry Facts" sheet on gating calculations from the May issue.

L. A. DUNBAR, *Director*
Shop Training
Aluminum Co. of America
Massena, N. Y.

■ Please forward four sets of tear sheets on *"Stopping Blow-By in Core Boxes"* by Richard L. Olson, pages 101-103, May issue.

L. CURRIE, *Asst. to Pres.*
Gale Manufacturing Co.
Albion, Mich.

■ I would appreciate receiving two copies of the article *"Semi-Automatic Muller Control"* by Thomas F. Murphy, page 67 of the April issue.

C. C. BUIK III, *Plt. Eng.*
Taylor-Wharton Iron & Steel Co.
High Bridge, N. J.

■ Please send tear sheets of the following articles which appeared in the March issue of AMERICAN FOUNDRYMAN: *"Core Veining"* by Roy Korpi and Gene Passman, and Gene Passman, and *"Vacuum Test Shows Up Gassy Metal"* by W. D. Walther, C. M. Adams, and H. F. Taylor.

ALVERD C. LUELLOFF,
Methods Eng.
Belle City Malleable Iron Co.
Racine, Wis.

■ Please send tear sheets of *"Sampling for Simplified Scrap Control"* by D. J. Kaufman and R. E. Johnston from the March 1955 issue.

H. H. LURIE,
Chief Metallurgist
Cummins Engine Co., Inc.
Columbus, Ind.

■ We would appreciate copies of the following articles printed in the March issue: *"Cleaning Room Production Control . . . Costs . . . Communications,"* H. A. Graber; *"Developing All Levels of Foundry Management,"* D. F. Lane; and *"Sampling for Simplified Scrap Control,"* D. J. Kaufman and R. E. Johnston.

F. V. HERR, *Mgr. Ind. Eng.*
Pratt & Letchworth Div.
Dayton Malleable Iron Co.
Buffalo, N. Y.

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New York—Combined Supply & Equipment Co.
Buffalo 7

New York—G. W. Bryant Core Sands, Inc.
McConnellsville

Ohio—Stoller Chemical Co.
Akron 20

Oregon—La Grand Industrial Supply Co.
Portland 1

Pennsylvania—Pennsylvania Foundry Supply & Sand Co.
Philadelphia 24

Tennessee—Robbins & Bohr
Chattanooga

Washington—Carl F. Miller & Co., Inc.
Seattle 4

Washington—Pearson & Smith Distributing Div., Spokane Pres-To-Log Co.
Spokane

Wisconsin—Interstate Supply & Equipment Co.
Milwaukee 4

Canada—Canadian Foundry Supplies & Equipment, Ltd.
Montreal, Quebec (Main Office) and Toronto, Ont.

NATIONAL BENTONITE
helped manufacture
this Caterpillar® giant!
This Caterpillar® DWSI Tractor and Scraper — shown stripping blow sand overburden from a deposit of bentonite — had many of their important parts cast in molds bonded with this same mineral. Casting for such heavy equipment must obviously be cast sound without any defects. That's why scores of good foundrymen the nation over specify National Bentonite to bond their molds. It's mined from the purest deposits of bentonite in the world . . . provides greater mold permeability, higher tensile strength, good green strength, higher hot strength, higher sintering point, and many other advantages.
Whatever the metal you're pouring — malleable iron, gray iron, steel, brass, aluminum, or magnesium — National Bentonite used as a bonding agent in your sand will produce finer, smoother castings and cut your reject loss. There are scores of good reasons why you should specify National Bentonite. Write today for folder and technical specifications.
100 LBS. NET
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BENTONITE
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Baroid
Baroid Division ☆ National Lead Company
Bentonite Sales Office: Railway Exchange Building, Chicago 4, Illinois

For more facts, circle No. 81 on postage-free Reader Service card on p. 103 or 104

AFS Technical Division Officers Are Announced

Officers of American Foundrymen's Society technical divisions and general interest committees announced by Frank J. Dost, Sterling Foundry Co., Wellington, Ohio, then president of AFS, at the annual meeting of the Society in Houston, Texas, are:

BRASS & BRONZE DIVISION
chairman: Harry C. Ahl, Jr., National Bearing Div., American Brake Shoe Co., Meadville, Pa.; *vice-chairman:* Roger J. Keeley, Ajax Metal Div., H. Kramer & Co., Philadelphia.

EDUCATION DIVISION
chairman: William H. Ruten, Polytechnic Institute of Brooklyn, New York; *vice-chairman:* Burton L. Bevis, Caterpillar Tractor Co., East Peoria, Ill.

GRAY IRON DIVISION
chairman: C. K. Donoho, American Cast Iron Pipe Co., Birmingham, Ala.; *vice-chairman:* Frank T. McGuire, Deere & Co., Moline, Ill.

LIGHT METALS DIVISION
chairman: E. V. Blackmun, Aluminum Co. of America, Pittsburgh, Pa.; *vice-chairman:* Donald L. LaVelle, Federated Metal Div., American Smelting & Refining Co., Barber, N. J.; *secretary:* John G. Mezoff, Dow Chemical Co., Midland, Mich.

MALLEABLE DIVISION
chairman: Frank B. Rote, Albion Malleable Iron Co., Albion, Mich.; *vice-chairman:* Eric Welander, John Deere Malleable Works, Deere & Co., East Moline, Ill.

SAND DIVISION
chairman: O. Jay Myers, Archer-Daniels-Midland Co., Minneapolis; *vice-chairman:* Elmer C. Zirzow, Werner G. Smith, Inc., Cleveland.

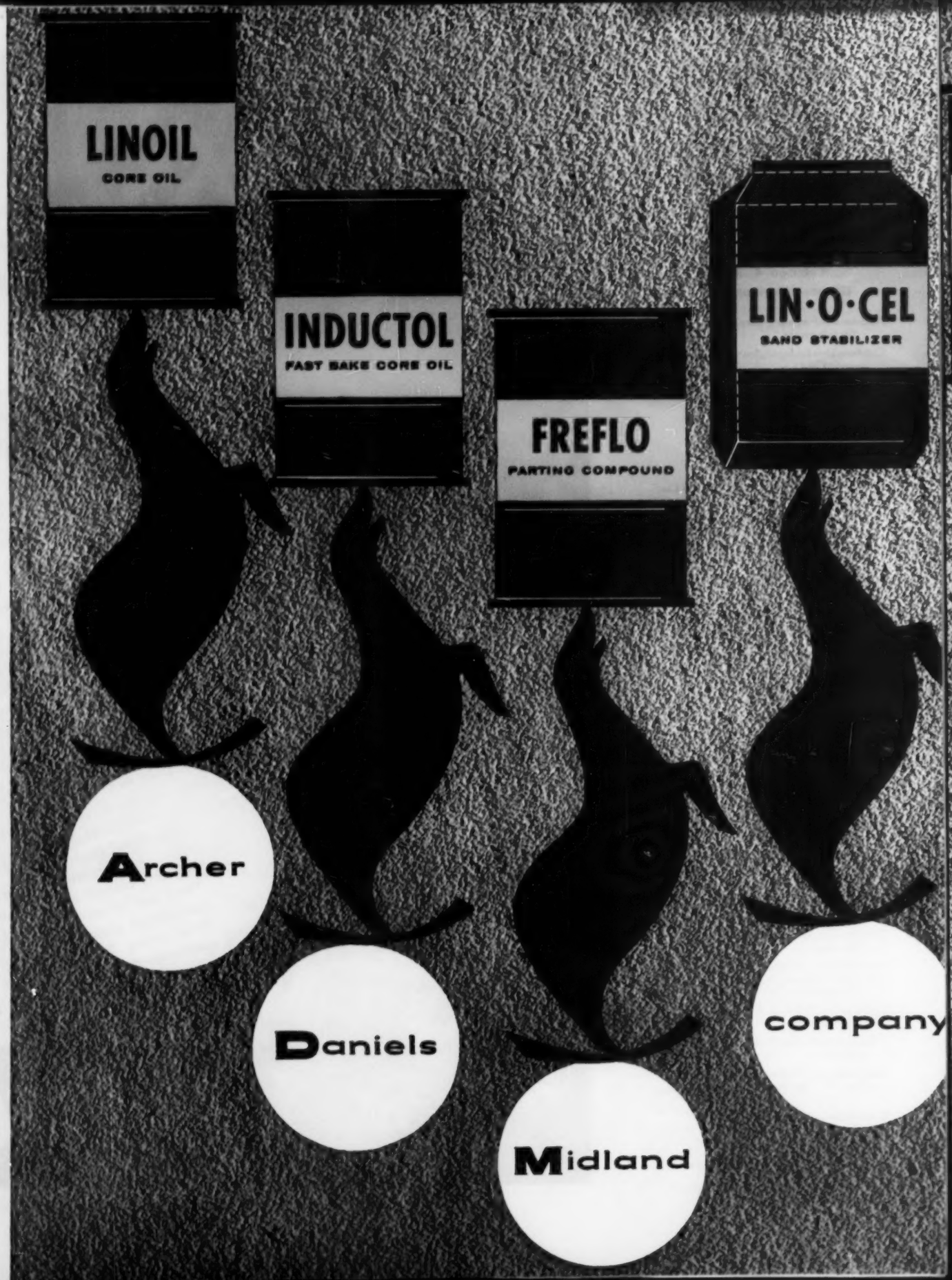
STEEL DIVISION
chairman: Victor E. Zang, Unitcast Corp., Toledo, Ohio; *vice-chairman:* James H. Lowe, Mid-Continent Steel Casting Corp., Shreveport, La.

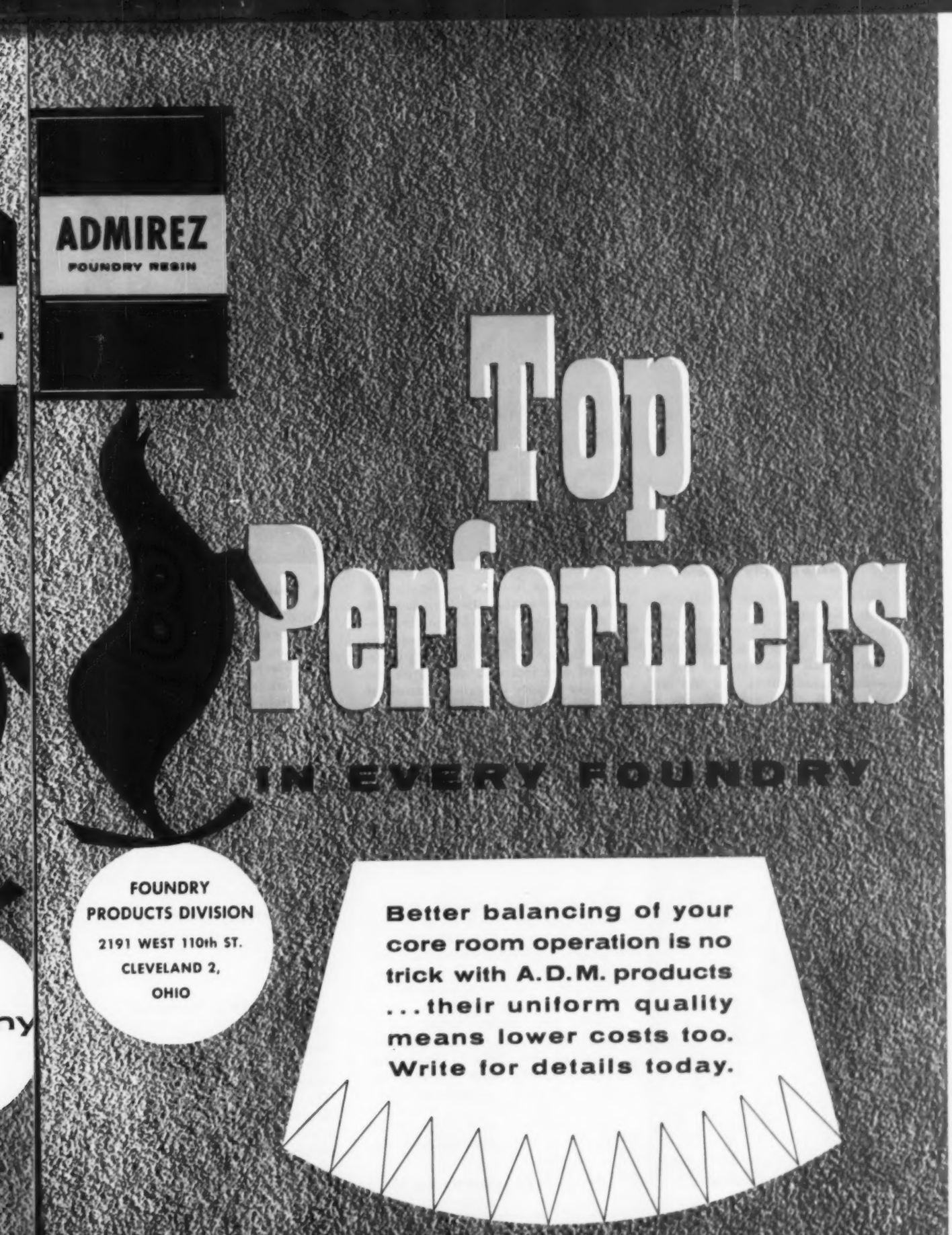
PATTERN DIVISION
Elects officers on even numbered years.

HEAT TRANSFER COMMITTEE
chairman: Charles Locke, Westlectric Castings, Inc., Los Angeles.

INDUSTRIAL ENGINEERING COMMITTEE
chairman: J. J. Farkas, Cincinnati Milling Machine Co., Cincinnati.

Other general interest committees have not yet elected new officers.

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FOUNDRY RESIN
Top Performers
IN EVERY FOUNDRY
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2191 WEST 110th ST.
CLEVELAND 2, OHIO
Better balancing of your core room operation is no trick with A.D.M. products ...their uniform quality means lower costs too. Write for details today.

Seeks Old Transactions

The national headquarters of American Foundrymen's Society has an urgent need for used volumes of the official society *Transactions*.

The years specifically sought are 1947-1952, inclusive, through Volume 60. Books must be in good condition, and will be purchased at $2.50 each. Copies should be mailed to Book Section, American Foundrymen's Society, Golf & Wolf Roads, Des Plaines, Illinois.

Investment Casters Meet

Technical sessions highlighted the May 4-6 meeting of the Investment Casting Institute at the Park Sheraton Hotel, New York. Subjects covered included *"Development of Specifications Applicable to Investment Cast Metals"* by Charles Yaker, Misco Precision Casting Co., Whitehall, Mich., chairman of the Institute's Metal Specifications Committee; *"Outline of Recommended Melting Practices for Small Heats"* by Nicholas J. Grant, Massachusetts Institute of Technology, Cambridge; *"Gating, Sprueing, Risering"* by Howard F. Taylor, M.I.T.; *"Standard Test Bars for Investment Castings"* by B. W. Duncan, Alloy Precision Castings Co., Cleveland, chairman of the Institute's Physical and Non-Destructive Testing Committee; and *"Proposed Investment Casting Design and Drafting Manual"* by E. G. Chapman, Cooper-Chapman Ltd., Toronto, chairman of the Institute's Dimensional Tolerances Committee.

Afternoon technical sessions were devoted to talks by W. A. Dubovick, chairman of the Institute's Process Materials Standards Committee, who spoke on *"Test Methods and Specifications for Process Materials;"* Dorian Shanin of Rath and Strong, who reported on *"Quality Pre-Control of Investment Casting Production;"* and James H. Moore, Vacuum Metals Corp., who spoke on *"Vacuum Melting—Possible Tool for Investment Casters."*

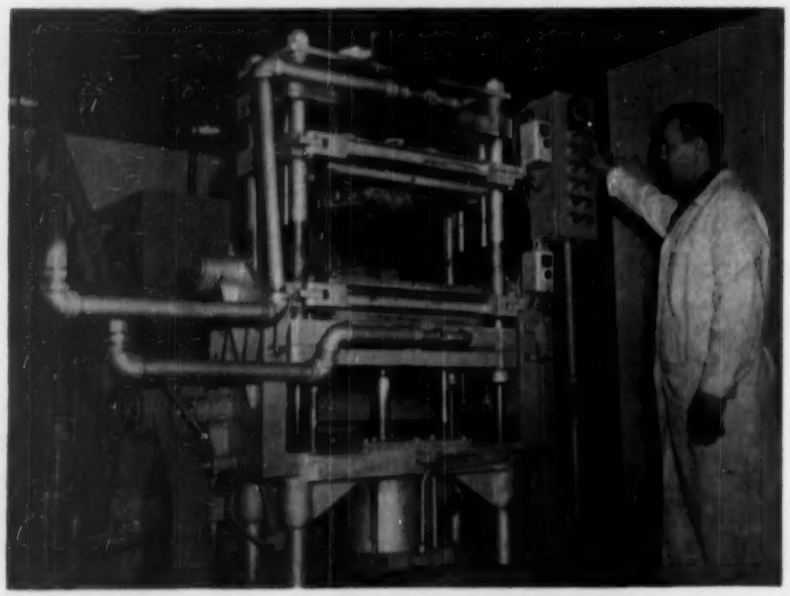
As part of the business sessions of the Institute meeting, K. J. Yonker, Misco Precision Casting Co., reported on *"Methods of Estimating Investment Casting Costs,"* while V. S. Lazzara, Casting Engineers, Inc., Chicago, reported on *"Study and Discussion of Typical Investment Casting Cost Estimates."*

products and processes

▼ 3-in-1 Core and Mold Blower

Versatile, new Sutter SP-1300 core and mold blower produces ready-to-use resin-bonded cores of three types: shell core, shell mold, and solid core. All are automatically blown and baked at the rate of 50 to 90 cycles an hour. Pre-coated sand mixed in equipment commonly used for green sand mixtures is used in the new unit. Core ovens and driers are eliminated. The machine uses gas-heated (ceramic burners) split core or mold boxes. Heat to each half of box is independently, thermostatically controlled. Operator merely removes finished cores and presses "start" button to initiate new cycle; machine does all the rest in a series of independently adjustable movements. All movements are air-actuated, electrically controlled. Box size maximum is 14 x 24 in., 7 in. deep; maximum draw is 3½ in. Little venting of boxes is required since clearance around stripper pins generally provides ample escape for exhaust air. Shell cores of high collapsibility and about one-third the weight of a solid core are produced rapidly and ready for setting as they come out of the machine. Solid cores require a slightly longer baking time than shell cores. Shell molds are produced with precision backs that permit stacking for horizontal pouring, or clamping mechanically. *Sutter Products Co.*

For more facts, circle No. 1 p. 104



Smoke Density Indicator

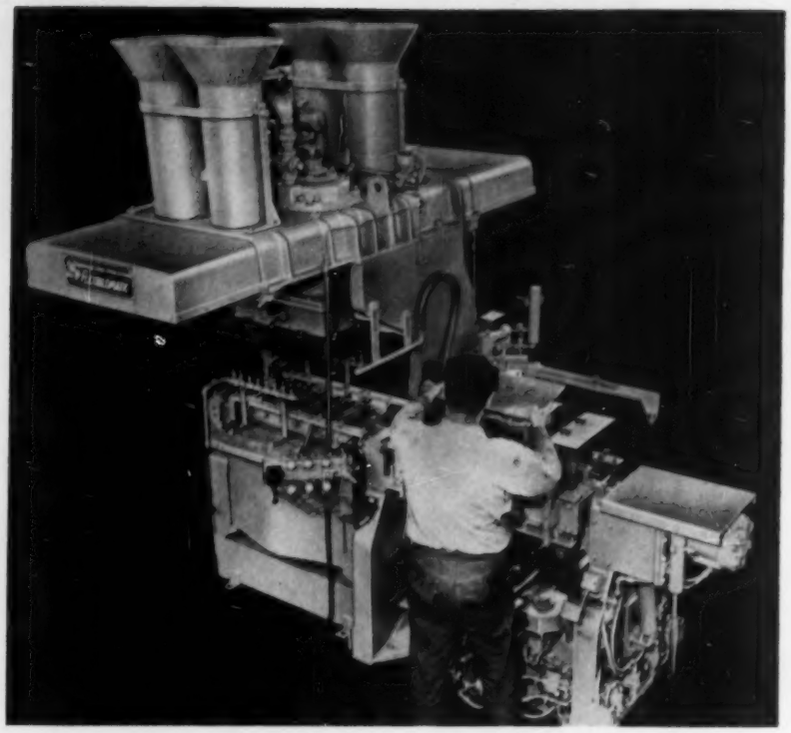
Fireye Smoke Density Indicator System FE-3 makes available to industry a new and more efficient method for keeping smoke discharge within limits of all smoke control and air pollution ordinances. For use with the system, three smoke density recorders, Series 55, are available. System FE-3 consists of a light source, a photoelectric scanner and a smoke density indicator. Light source and scanner are installed on the stack or breeching so that the light beam is aimed directly at the lens of the scanner. The density of smoke obscuring the light beam is accurately measured and indicated directly on the smoke density indicator in terms of both smoke density and Ringelmann Number. An alarm relay provides for the operation of an external alarm at any preset value of smoke density. *Combustion Control Div., Electronics Corp. of America.*

For more facts, circle No. 2 p. 104

Rubberized Abrasive Kit

A comprehensive polishing kit to handle deburring, smoothing and polishing applications has been developed. Kit contains an assortment of 24 Cratex polishing wheels, cones, blocks and mandrels which are in wide use in industry. Each kit contains full instructions on the application of Cratex rubberized abrasives perfected to give a "cushioned action performance" in burring, smoothing and polishing on hard or soft metals, plastics, ceramics, glass and other materials. *Cratex Mfg. Co.*

For more facts, circle No. 3 p. 104



▲ Automatic Coreblower

The B & P Flexiblomatic coreblower is all-new, all-pneumatic and all-automatic. Is simple to operate and easy to service since there are no electrical contacts or relays. New unit blows, rolls over, and draws 240 cores per hour. Indexing of the box, blowing, roll-over and drawing, ejection and delivery of the box are all automatic. Operator need only actuate one valve, place a core plate and remove a finished core on each cycle. New TR Cormatic Units with Flexiblomatic coreblowers are available to blow, rollover and draw cores weighing up to 60 lb. *Beardsley & Piper Div., Pettibone Mulliken Corp.*

For more facts, circle No. 4 p. 104

Metal Filler Compound

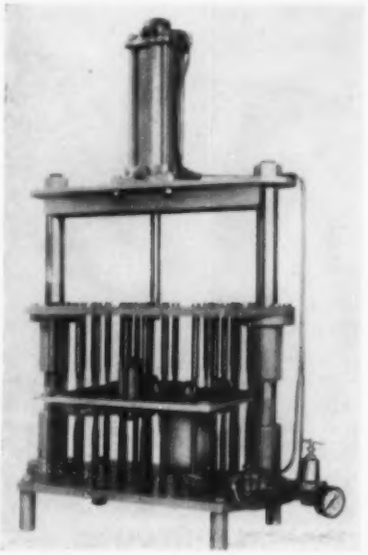
An aluminum based, putty-type metal filler compound, destiMETAL, and a thinner and solvent called destinSOL have been announced. The filler is actually a metal alloy in plastic form, which can be applied without heat, as a filler, to other metals, wood, plastics, fibre glass and plaster. In its straight form, it is said that the new compound is used as a

permanent metalfiller. DestiMETAL is reported in use for repair of patterns, molds, dies, models, matchplates and valves. In machining, it is stated that it can be drilled, milled, tapped, sanded, filed, ground, and generally worked as any other metal alloy. When thinned with destinSOL, the metal filler compound can be sprayed on metal, wood, plastic, fibre glass and plaster surfaces as a coating or lining. Literature describing the two products can be obtained by writing *Destiny Products Co.*

For more facts, circle No. 5 p. 103

Shell Fusers

A new line of pin-type foundry shell fusers has been announced. Molds up to 48 by 48 in. can be accommodated. The smaller machines are designed for molds up to nine in. deep; the larger machines are made to order

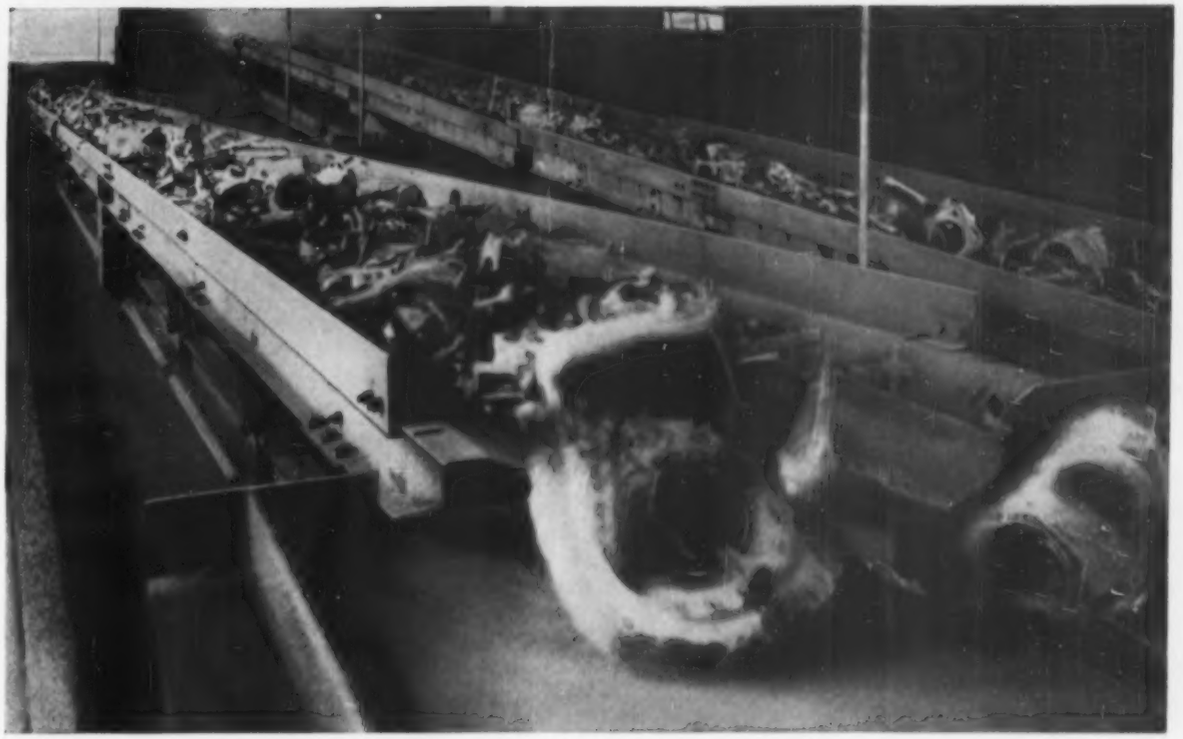


for whatever maximum depth is required. Pin-type fusers will be made in the same size as the shalco vacuum-type fusers: 16 x 20 in., 20 x 30 in., 30 x 36 in., 40 x 40 in., and 50 x 50 in. *Shalco Engineering Corp.*

For more facts, circle No. 6 p. 103

Chromium Plating

New production plating process that deposits a chromium plate directly on steel has been announced. Called Crack-Free Chromium, the new plate is deposited free of any structural imperfection that would allow corro-



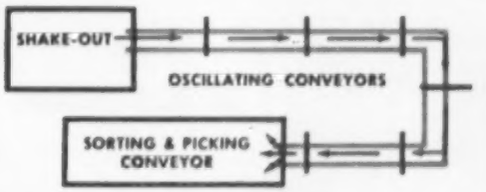
Large foundry mechanizes with 1650 ft. of LINK-BELT Oscillating Conveyors

Trouble-free system has capacity for cooling 400,000 tons of gray iron castings annually

PLANNING with this foundry's engineers, Link-Belt specialists found that the best cooling arrangement involved gentle movement of castings by oscillating conveyors up a 5-degree incline from shakeout to sorting. They designed a system of Link-Belt oscillating conveyors which permits continuous material flow . . . has brought safer, cleaner working conditions in the bargain. What's more, this gentle handling has eliminated damage to castings experienced in other types of conveyors in discharging from one unit to another.

Better cooling of castings on oscillating conveyors is but one phase of foundry engineering and equipment pioneered by Link-Belt. Our engineers can plan an entire conveying and sand preparation system for you . . . and follow through with a complete line of quality equipment to help you produce better castings at lower cost.

Whether you need one machine or complete engineering, call your nearest Link-Belt office. Be sure to inquire about stock availability of standardized sections of 36-in. oscillating conveyors, that cut both costs and delivery time. Also, get Book 2423 for complete information on Link-Belt's broad line of foundry equipment.



Layout of typical foundry oscillating conveyor application

AT LARGE MIDWEST FOUNDRY, gray iron castings cool on 48-in. Link-Belt oscillating conveyors specially designed for gentle handling and cooling of hot castings —operating at 12 to 15 ft. per minute. Positive action, constant-stroke eccentric moves materials in uniform flow regardless of surges. Other 36-in. wide oscillating conveyors are also important in this foundry's operations.

LINK-BELT

CONVEYORS AND PREPARATION MACHINERY

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

For more facts, circle No. 82 on postage-free Reader Service card on p. 103 or 104

OREFRACTION
ZIRCON
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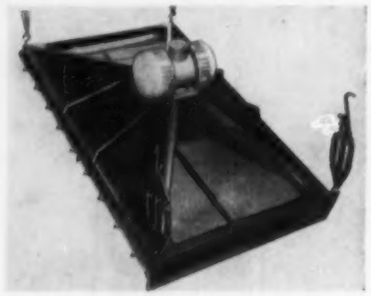
AND
FLOUR
Orefraction Inc.
7425 THOMAS ST., PITTSBURGH 8, PA.
DISTRIBUTED BY
For more facts, circle No. 83 on postage-free Reader Service card on p. 103 or 104

sive materials to come in contact with the underlying surface being protected. As a result, it can be plated directly on steel, without the necessity for an undercoat of nickel or copper and nickel. Other desirable properties of the deposit include: low coefficient of friction, excellent adhesion, a non-galling surface and superiod ductility. Deposit has a light gray matte appearance and can be readily buffed to a high luster. *United Chromium, Inc.*

For more facts, circle No. 7 p. 104

Vibrating Screen

New Syntron-Sinex Screen provides fast uniform sizing of materials and is available in single or double deck models either in open style, or totally enclosed. It is designed for suspension mounting. Vibrating unit is a totally enclosed, pressure tight, waterproof,



permanently lubricated electric motor with unbalanced weights on the shaft. Screen area is vibrated 3600 vibrations per minute with an amplitude of 3/16 in. Specific application data, requirements and literature are available. *Servad, Inc.*

For more facts, circle No. 8 p. 104

Welding Electrodes

Two new electricides, Pacific Silicon Bronze and Aluminum Bronze, have been placed on the market. Pacific Silicon Bronze Electrodes can be used for either AC or DC welding of silicon bronze and all Everdur alloys. Because of its smooth bead deposit and ease of application, it can be used in all positions. Aluminum Bronze Electrodes can be used on steel, malleable and cast iron and

continued on page 120

FOR SMOOTHER CORES

KORGLAZE

...FINER CASTINGS

Aqua-Bond

310

Long before this Bronze Bell was cast, foundries were aiming for finer castings in the non-ferrous field—castings with a smoother "As Cast" surface. Today it's a bullseye with Korglaze.

Korglaze is a vehicle to which graphite is added for spraying cores and molds. It will air dry, tying the graphite firmly down and will produce castings with an "As Cast" surface, smoother than you have ever imagined. It saves time, material, cleaning and rejects and will repay its cost many times over in the upgrading and eye appeal of your castings. Can you afford to be without it?

Aqua-bond is another aid to finer castings. This emulsified oil shows special value because, in baking, cores will be processed to an open condition favorable to the fast escape of gas and a free tendency to collapse early on pouring. Why? The answer is that an emulsion will not migrate on heating, but takes an initial set just when heat breaks it to drive the water off. This gives close bonding between the sand grains and protects cross sectional strength in the core. In the second place, an emulsion is exceedingly clean to use, free from objectionable odor and lower in gas, pound for pound, than are core oils or straight Linseed.

Write us for more data on Korglaze and Aqua-bond.

The Bronze Bell reproduced in our ad is shown through the courtesy of the Allen Memorial Art Museum of Oberlin College. We will be glad to furnish a description of the bell if you write us.

UNITED OIL MFG. COMPANY

1429 WALNUT STREET, ERIE, PA.

Hot under the collar

...or Chuck Wright's key to top performance

"PANCAKE DAY... the Tuesday before Lent . . . opened bright and sunny. But to Ernie Burgess, Nonesuch Foundry's super., it was a bleak morning," announced Chuck Wright.

"When I stepped into his office," added the INCO distributor foundry specialist, "Ernie was patting a handkerchief to the back of his neck. He looked like a man who could really use a pancake today. For a poultice.

"All I could do was ask: 'What's the strife, Ernie?'

" 'One of our best customers,' he complained, 'one of our largest users of compressor cylinder castings . . . pffft . . . right out the window.'

"Not a pleasant surprise, I thought, to lose that business. And they lost it in spite of technical progress made in this foundry over the past several years.

"It was another case of too many rejects. Hard spots, porosity, lack of uniform, close grain lost it. The customer needed pressure tightness in the cylinders. Plus good machinability, and wear resistance.

"I pointed out to Ernie that he might possibly get these properties by maintaining precise control of the basic chemical composition, the pouring temperature, the sand condition and so forth. I realized, of course, that holding all these to very narrow limits is a terrific gamble for anybody.

"But no foundryman needs to gamble . . . not even with a single heat. So I said to Ernie, 'You know I've told you before how to get exactly what this buyer wants. Relax, man. Use a little nickel.'

"Ernie followed my suggestions. He added 1 to 1½% nickel. From this mix, he shipped a few sample castings to the former customer.

"And here's what happened. Ernie has the customer back on the order book again and Nonesuch is getting new business from other accounts. Every one of them calling for castings that not only machine readily, but also to meet other specific demands. They want wear resistance, higher strength and the like . . . for end-uses requiring top performance.

"There's been a lot of progress made in foundry technique. But after all, you'll find that use of a little nickel will stop a lot of troubles . . . in the machine shop as well as in the foundry and in the field.

"Next time there's a hitch in your work, you may want some practical answers on the metallurgy of castings. Just call on me for help."

Chuck Wright

P. S. "The easiest way is to drop me a line in care of INCO."

INCO TRADE MARK

The International Nickel Company, Inc.
67 Wall Street New York 5, N. Y.

for the asking

Sulphur in Hydrocarbons

Literature is available describing an empirical method for the rapid analysis of surphur in oil, oil additives, rubber, coal, coke and other hydrocarbon materials. Analysis time is 3-10 min depending on the type material tested compared with 1-6 hours by the bomb procedure. Results are generally in agreement with the usually employed analysis procedures. Additional advantages to the method are those attributable to using an induction furnace and automatic titrator. *Laboratory Equipment Corp.*

For more facts, circle No. 45 p. 104

Gas Scrubbers

Bulletin M-103 has been prepared describing Venturi Gas Scrubbers. Concisely describes the distinctive features and operations of these scrubbers and their application to cupola fumes, electric furnaces, blast furnaces, and oxygen steel converters. Also included in the bulletin are typical flow sheets, performance tables and curves for a range of dust loadings and photographs of some representative installations. *Chemical Construction Corp.*

For more facts, circle No. 46 p. 104

J. I. C. Pneumatic Standards

Complete, unabridged, revised-up-to-date copies of the J. I. C. Pneumatic Standards for Industrial equipment, incorporating all revisions made in the January, 1955 meeting of the Joint Industry Conference, are now available. Printed as a 12-page booklet, it contains a word-for-word reprint of the Standards, two pages of graphical symbols, a sample pneumatic circuit employing these symbols, a glossary of terms used and other interesting information. Booklet is hole-punched for convenient insertion in standard ring-binders. *Miller Fluid Power Co.*

For more facts, circle No. 47 p. 104

Ball Bearing Trolleys

Catalog No. 2536 describes an entirely new line (Series 500) of ball bearing trolleys for overhead conveyors. The 20-page book includes description and dimension data on the entire line, application data, and description of the commonly used attachments, to facilitate selection of new or replacement trolleys. *Link-Belt Co.*

For more facts, circle No. 48 p. 104

Two-Stage Compressors

Bulletin 16B8244, describes two-stage, sliding vane-type compressors for shop air, gas handling, drilling and many other applications. Built in various sizes to deliver air at pressures from 60 to 125 lb gauge, compressors are designed for low maintenance and constant efficiency. In addition to a table of ratings for the compressor, bulletin carries a table of outline dimensions for the units. *Allis-Chalmers Mfg. Co.*

For more facts, circle No. 49 p. 104

Ball-Bearing Lubrication

Bulletin No. 506 offers information on lubrication and maintenance of ball and roller bearings. Complete with helpful lists of "Do's" and "Don'ts" to prolong bearing life,

Just Out!

Completely
Revised
Enlarged
2nd Edition

THE CUPOLA AND ITS OPERATION

Completely revised edition of THE CUPOLA OPERATIONS HANDBOOK. For ready reference by metallurgists, operating foundrymen, and the students of foundry technology, the 35 chapters are grouped into the following sections: Operations, Equipment, Materials, Principles Related to Operations.

Latest developments, such as hot blast, basic lining for nodular iron, and emission control are covered. Other chapters such as those on refractories, principles of combustion, and metallurgy have been greatly augmented or are presented for the first time.

Chapter headings include:

Calculating the Cupola Charge	Basic Cupola
Cupola Lining and Daily Maintenance	Mechanical Charging Equipment
Coke Bed	Forehearths-Ladles
Operating Techniques	Cupola Fuels
Control Tests	Refractories
Composition Control	Thermal Chemistry

300 pages *8½ x 11 Casebound* *328 Illustrations* *54 Tables*
Members $6.00 *Others $9.50*

AMERICAN FOUNDRYMEN'S SOCIETY
616 South Michigan Avenue
Chicago 5, Illinois

Please send me _____ copies of THE CUPOLA AND ITS OPERATION.
I enclose $_____ Cash ☐ Money Order ☐ Check ☐ to cover.
Please send invoice ☐ A

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COMPANY_____
ADDRESS_____
CITY_____ P. O. ZONE ____ STATE_____

AFS pays postage when remittance accompanies order (USA only)

bulletin also includes valuable information on the storage and handling of lubricants. *New York & New Jersey Lubricant Co.*

For more facts, circle No. 50 p. 104

Core Box & Fillet Machine

Literature is now available describing the Glover Core Box and Fillet Machine, with a large ball bearing spindle. Lists five steps showing how unit can be set up in ten minutes. Also includes actual photos showing versatility of the machine. *Glover Mfg. Co.*

For more facts, circle No. 51 p. 104

Human Relations Publications

Booklet, now available, gives the history of the National Foremen's Institute and explains the purposes of the organization. Many of the bulletins and letters published by the organization are described. *National Foremen's Institute, Inc.*

For more facts, circle No. 52 p. 104

Electrode Classifications

A new Comparison Chart which lists electrode classifications and all major manufacturers' electrodes which fall into each individual class has just been issued. Welding electrodes covered include all classes of mild steel, stainless steel and special purpose electrodes used in manufacturing and maintenance. Also covered is the new McKay line of hard surfacing electrodes. *McKay Co.*

For more facts, circle No. 53 p. 104

Core Binder

Pamphlet introduces Dexocor, a dry core binder to give baked strength in cores. Points out how Dexocor simplifies mulling operation, checks veining, increases green strength and shortens baking time. *Corn Products Refining Co.*

For more facts, circle No. 54 p. 104

Temperature Conversion Chart

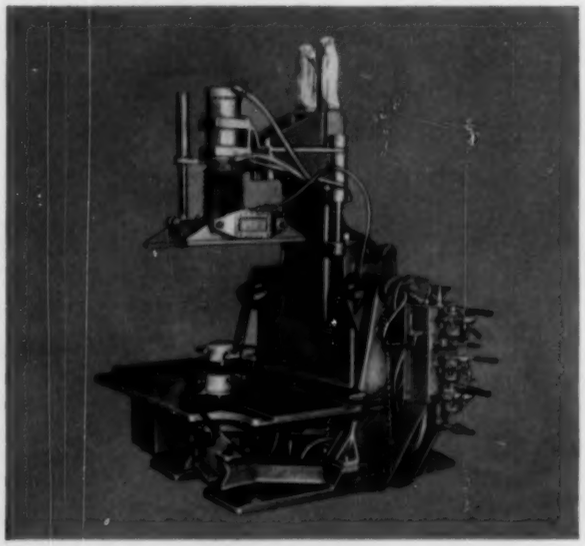
New, pocket-size bulletin, containing charts for wire gauge and temperature conversion, is now being offered. Bulletin, GEZ-1510, enables the user

(ADVERTISEMENT)

Modern Equipment Saves Money For Foundries

MAXIMUM CAPACITY, with full development of molding and core sand physical properties is essential at the Kensington Steel Company. This single Model "70" Speedmullor prepares over 270 tons of molding and core sand daily. Mulling and cooling of molding sand is accomplished in a total cycle of 70 seconds. *For full information write Beardsley & Piper, 2424 N. Cicero Ave., Chicago.*

80 TO 100 LARGE MOLDS are rammed each hour by this remote controlled Hydra-Slinger at the Belle City Malleable Iron Company. Patterns for eight different jobs are mounted on Champion Speed-Draw Machines on a continuously rotating B&P Rotomold table. The Hydra-Slinger offers effortless, high-speed ramming for jobbing and production foundries. *Write now for full information: Beardsley & Piper, 2424 N. Cicero Ave., Chicago.*



JOB CHANGE DOWNTIME was a problem at one large gray iron foundry until this new J&J Jolt Rol-A-Draw with Automatic Adjustable Flask Equalizer and Automatic Pattern Clamps was installed. Pattern boards are mounted by a "flick" of a single lever, and various flask heights are automatically accommodated. J&J Rol-A-Draws are available with capacities to 10,000 pounds. *Beardsley & Piper, 2424 N. Cicero Ave., Chicago, will provide complete details.*

COREBLOWING FOR THE JOBBING FOUNDRY is made practical by devices like the quick-change magnetic blow plate holder on this CB 5 Core Blower at the W. D. Allen Mfg. Company. A permanent magnet device in the sand magazine clamps the blow plate securely in position. Locater pins insure exact positioning. To disengage a plate, the operator has only to pull it off. Full details are available. *Write to Beardsley & Piper, 2424 N. Cicero Ave., Chicago.*

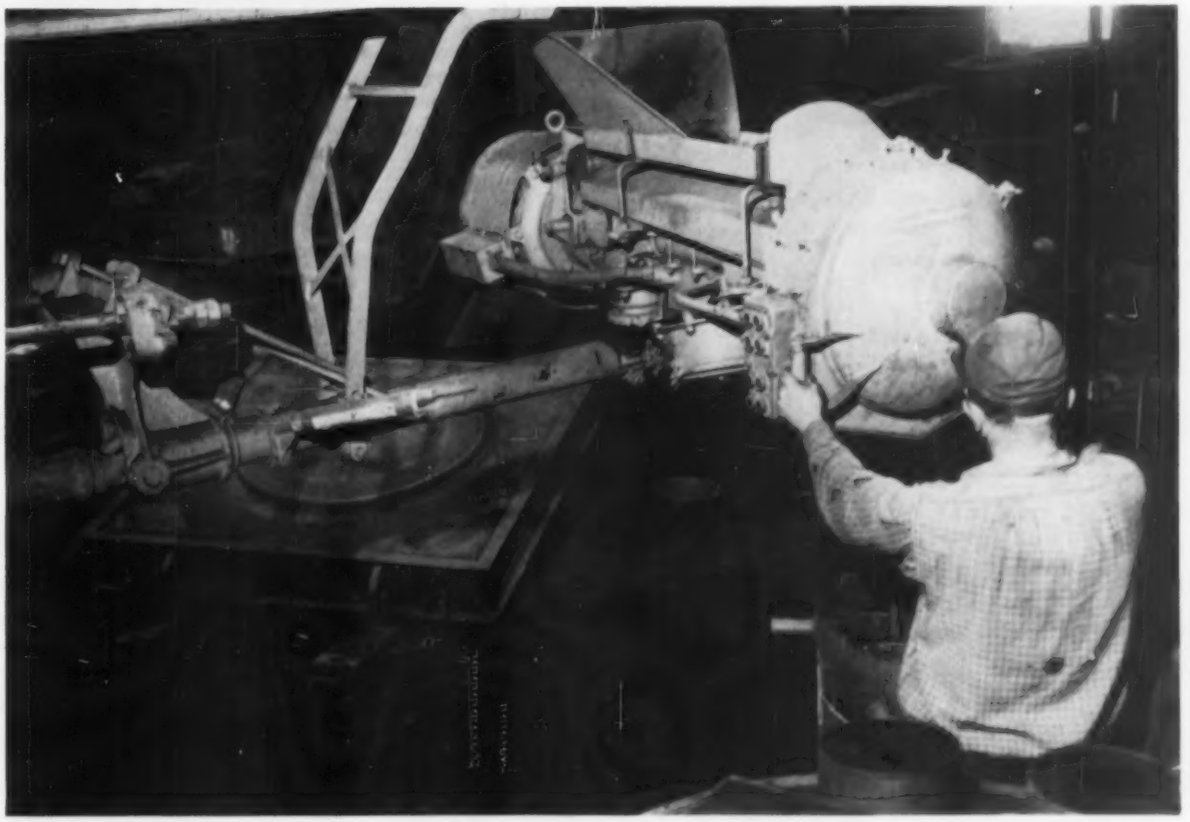
For more facts, circle No. 84 on postage-free Reader Service card on p. 103 or 104

(ADVERTISEMENT)

THE MOLDING SAND FOR UP TO 50 FLOORS is thoroughly prepared daily by this Nite Gang at the G & C Foundry. Shakeout sand heaped on the floors is thoroughly blended and then elevated and discharged over a magnetic separator. The scrap-free sand is then aerated, screened, aerated again and discharged into a pile or windrow ready for use. The machine is self-loading and self-propelling. *For full details, write Beardsley & Piper, 2424 N. Cicero Ave., Chicago.*

MOLDS FOR A LARGE NUMBER of different castings are produced efficiently by this Tractor Sandslinger at the Forest City Foundries. Cope and drag patterns are mounted on two portable pin-lift machines towed behind the slinger as it moves into the sand heap. Patterns are easily changed, and production from varied patterns is high. Effective mechanization has been attained at very low cost. *For full information write to Beardsley & Piper, 2424 N. Cicero Ave., Chicago.*

EXACT LABORATORY CONTROL of sand preparation requires laboratory mulling equipment that will do a thorough job of developing full sand physical properties in minimum time. The compact Lab Mulbaro is designed for fast complete mulling. Mulling bowls are removable to simplify laboratory procedures. *Beardsley & Piper, 2424 N. Cicero Ave., Chicago.*



THE MEECH FOUNDRY is small and space for molding is at a premium. Headroom is only 12′ and the molding bay is less than 30′ wide. Yet, Meech is getting the full benefits of slinger mechanization with a Motive Sandslinger which rams all of their molds except for squeezer work. *More information may be obtained by writing to Beardsley & Piper, 2424 N. Cicero Ave., Chicago.*

to convert wire gauge sizes to decimal dimensions of base wire diameter. A temperature conversion table on the reverse side is expressed in Centigrade and Fahrenheit scales, range 0 F to 3772 F. It is printed on durable plastic material. *General Electric Co.*

For more facts, circle No. 55 p. 104

Spectrographic Circuits

Bulletin 35A contains detailed information on the three circuits available in spectrographic source unit which enable the spectroscopist to select optimum conditions for a wide range of analytical problems. A selector switch permits quick and easy change from the three basic circuits —high voltage condensed spark, AC arc and DC arc—without physically changing the leads. Specifications and features of the circuits are presented, together with schematic diagrams of each. *Baird Associates, Inc.*

For more facts, circle No. 56 p. 104

Electric Vibrators

Catalog No. 11 describes the complete line of Cleveland Vibrator Company's electric vibrators. Specifications and prices are included. Information is also furnished for vibrating tables and pneumatic vibrators. Illustrations of vibrators in action, as well as information on mounting and installation are also included. *Cleveland Vibrator Co.*

For more facts, circle No. 57 p. 104

Safety Signs

New 48-page, five-color catalog, has just been issued which illustrates in actual colors over 2200 stock metal signs and safety tags. Many of the signs may be had in foreign languages. One of the features of the catalog is a section devoted to special signs made for specific accident prevention or commercial problems. *Ready Made Signs Co., Inc.*

For more facts, circle No. 58 p. 104

Colloidal Dispersions

A revised four-page booklet, "A List of 'dag' Dispersions for Industry," listing 44 colloidal and semi-colloidal dispersions for the metalworking,

1954

CHARLES EDGAR HOYT

Annual Lecture

"PROCESSING MOLDING SANDS"

By Harry W. Dietert

a comprehensive review covering:

- base materials
- blending
- additives
- cooling
- mixing
- tempering
- aerating
- ramming
- shake-out

The author discusses in detail how materials are processed to obtain molding sands that possess desirable properties to produce castings of high quality. The practice and theory behind blending is covered in detail. Data are presented on the various additives.

Bonding materials information is included as a guide to their proper choice and use. Various methods of mixing sands are reviewed. Recent developments concerning tempering sand by weight-moisture, deformation-moisture, conductivity-moisture, capacitance-moisture, and temperature-moisture relations are shown in detail.

Methods of aerating sand are described. The subject of reclaiming sands is covered by showing schematic diagrams of various processes.

32 pages 8½ x 11 paper-bound 63 illustrations
Members $1.50 Others $2.25

AMERICAN FOUNDRYMEN'S SOCIETY
Gold & Wolf Roads
Des Plaines, Ill.

Please send me_____copies of PROCESSING MOLDING SANDS
I enclose $_____cash_____money order_____check_____to cover.
Please send invoice._____
Name_____
Company_____
Address_____
City_____P. O. Zone_____State_____

(AFS pays postage when remittance accompanies order)

foundry and related industries, has just been issued. Products include dispersions of graphite, molybdenum disulfide, mica, vermiculite, zinc oxide and acetylene black. Carriers and diluents are given for each product, along with typical applications and important physical data. *Acheson Colloids Co.*

For more facts, circle No. 59 p. 104

Reconditioning Drums

Bulletin 113-D on cleaning steel drums in reconditioning has just been published. Well-illustrated publication shows how airless abrasive blast cleaning is being used at a number of plants. Four case histories are presented, as well as photographs of typical machines in use. Machines vary in type, according to the requirements of the production of the shop. *American Wheelabrator & Equipment Corp.*

For more facts, circle No. 60 p. 104

Tooling Materials

Bulletin, now available, describes Epocast Tooling Resins for foundry patterns, aircraft, automotive and commercial tooling. Points out how Epocast 2 is an unfilled, fast-setting, epoxy resin primarily intended for laminating at room temperature. States Epocast 502 sets more slowly than Epocast 2, which makes it very suitable for wet lay-ups of great area or for difficult configurations which require more time to smooth out the glass cloth to contour. Other casting resins are also described. *Furane Plastics, Inc.*

For more facts, circle No. 61 p. 104

Overhead Handling

Bulletin No. M-28 shows how Trambeam overhead handling equipment can provide efficient, precision handling in machining areas of the plant. Explains how machine operators at Verson Allsteel Press Co., Chicago, use Trambeam Cranes with pendant, push-button controls to place in position for machining, parts weighing as much as 10 tons. Eight installation photos are included. *Whiting Corp.*

For more facts, circle No. 62 p. 104

Air-Cooled Compressor

Bulletin, Form 1540, describes Model 20T compressor equipped with Ingersoll-Rand Channel Valve. The air-cooled, 20-hp compressor may be either direct-connected or belt-driven. Bulletin includes cutaway views and a table of specifications. *Ingersoll-Rand Co.*

For more facts, circle No. 63 p. 104

Welding Publication List

New 16-page booklet lists over 100 welding and cutting technical reprints, text books, safety booklets, slidefilms and movies. Convenient order cards, keyed for easy selection, are included for requesting items of interest. *Air Reduction Sales Co., Div. Air Reduction Co., Inc.*

For more facts, circle No. 64 p. 104

Conveyor Equipment

Catalog No. 400 covers four products: Magnavator, a completely automatic elevator for handling small parts magnetically; Tube-Veyor, a totally enclosed bulk material handling conveyor featuring a two-directional chain to convey in any direction; Chip-A-Way, a precision piano hinge steel belt conveyor elevator, press made; and Welded Tube, precision piano hinge steel belt conveyor, fixture welded. Custom built conveyor equipment such as bucket elevators, screw conveyors, belt conveyors, vibrators and vibrating conveyors, pneumatic conveyors and flux and chip handling systems, are also included. *Prab Conveyors, Inc.*

For more facts, circle No. 65 p. 104

Mobile Floor Cleaner

Bulletin No. 551 covers in detail the outstanding features and advantages of Floormobile for suction cleaning (instead of sweeping) dust, dirt, lint, trash, paper, etc., from large floor areas. Includes case history material and complete specifications. *Handling Devices Co., Inc.*

For more facts, circle No. 66 p. 104

AFS Publications Catalog

The 1955 AFS Publications Catalog lists available publications pertaining to ferrous foundry practice, non-ferrous foundry practice, general found-

ry interest, safety, hygiene & air pollution control, training and education, foundry costs and transactions. Form for easy ordering is also included. *American Foundrymen's Society.*

For more facts, circle No. 67 p. 104

Specialized Lubricants

Catalog is now available describing lubricants embodying McLube processed molybdenum disulfide and providing dry, liquid and greasfilm lubrication. Lists product number, form or consistency, description, diluent, temperature of application, type of lubrication and applications. *McGee Chemical Co., Inc.*

For more facts, circle No. 68 p. 104

Vitreous Enameling

Brochure is now available describing research with vitreous enameled aluminum castings. Outlines many of the general characteristics that can be obtained in the enameled finish as applied to Monarch Aluminum castings. *Monarch Aluminum Mfg. Co.*

For more facts, circle No. 69 p. 104

Industrial Trucks

The May issue of Storage Battery Power, describes and illustrates how the Vanadium Corp. of America's new plant in Graham, West Va., employs powered industrial trucks for in-process handling and shipping of ferro-alloys in unit loads—and how, at the Sparrows Point, Md. plant of Rheem Mfg. Co., powered trucks handle unit loads of steel through process unskidded by means of special handling aids at the entry and delivery ends of production lines. *Edison Storage Battery Div., Thomas A. Edison, Inc.*

For more facts, circle No. 70 p. 104

Crystalite Refractories

New 12-page bulletin, CR 11, describes how improved processing techniques gives new line of high-temperature Crystalite refractories, the following advantages: superior refractory qualities up to and including 3326 F (1830 C), high resistance

DELTA

Core and Mold Washes

for

Closer Tolerance.. Better-Finish Castings

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... Lower Cleaning Room Costs.....

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IMPORTANT REASONS WHY MORE FOUNDRIES USE DELTA CORE AND MOLD WASHES TO SPEED PRODUCTION AND REDUCE COSTS

DELTA CORE AND MOLD WASHES *"Anchor" themselves by penetrating from 4 to 7 grains deep into the sand.* This bond between the wash and the sand . . . an exclusive DELTA feature . . . produces an expansion-resisting coating essential to the production of finer finished castings.

The dry compression strength increases with each degree rise in temperature up to 500° F when the hot compression strength takes over. *The hot compression strength* increases with each degree of temperature rise up to 2900° F. The ultimate hot compression strength of the wash is over 1000 p.s.i.

There is no gas leakage through Delta Core and Mold washed surfaces. Gases produced by decomposition of organic binders in the core sand cannot leak through Delta Core and Mold washed surfaces to contact the molten metal. Only DELTA CORE AND MOLD WASHES provide this unique and all-important insurance against defective castings resulting from gas leakage.

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There is a DELTA Wash for every type of Metal Casting.

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MANUFACTURERS OF SCIENTIFICALLY CONTROLLED FOUNDRY PRODUCTS

MILWAUKEE 9, WISCONSIN

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to thermal spalling, highest resistance to structural spalling, and highest resistance to deformation at high temperatures. Tables list the physical and chemical properties of Crystalite grog, Crystalite refractory and Crystalite A refractory. Photos illustrate Crystalite bricks and special shapes, thermal spalling comparison tests and the seven mesh sizes available. *Richard C. Remmey Son Co.*

For more facts, circle No. 71 p. 104

Molding Machine

Folder is available describing Type B. T. 5 machines. A feature of the device is that the squeeze is effected on the presser plate and not on the rollers. When the ascending pattern is clear of the mold the rollers are automatically tipped by a pneumatic piston and the mold then rolls clear of the machine and on to an adjacent roller conveyor. Roller head can be arranged for mold removal at either side or at the front of the machine. *Stamford Engineering Works,* American representatives of *British Molding Machine Co., Ltd.*

For more facts, circle No. 72 p. 104

Compressor Units

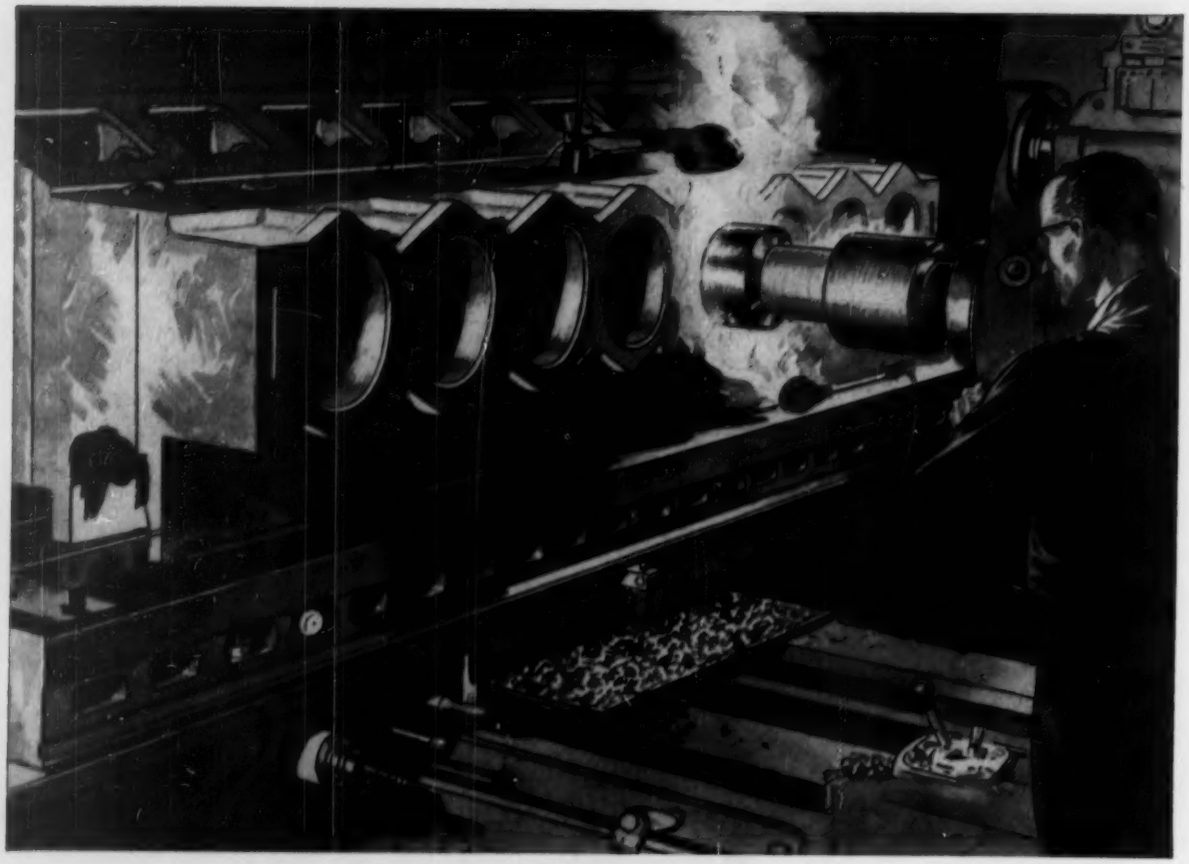
Bulletin No. 76, a 24-page engineering bulletin, describing the latest V-angle engine driven compressor has just been released. Booklet provides technical data on the latest developments in compressor design for further improving fuel economy and increasing capacity and range of operation. Available in 4-6-8-10 cylinders of 9¾ in. bore and 10½ in. stroke, the GMXD compressor develops 265 to 660 hp at 450 rpm. *Cooper-Bessemer Corp.*

For more facts, circle No. 73 p. 104

Shell Molding

Bulletin CDC-272-A, Shell Molding Manual, gives an introduction to shell molding; lists the advantages of shell molding; gives a comparison of shell molding and overlapping processes and lists the fundamental steps of shell molding. Trouble shooting hints, shell molding testing methods and procedures and application studies are also included. *General Electric Co.*

For more facts, circle No. 74 p. 104



Insure good machinability with as little as 2 to 4 lb. of SMZ alloy per ton of Iron

Today's high-speed machining operations make it more important than ever to control the structure of iron castings. Castings with chilled corners and edges or hard spots may cause costly tool breakage and interrupted production.

An effective, low-cost method of insuring satisfactory machinability is the addition of SMZ alloy to the iron in the ladle. An addition of only 2 to 4 lb. per ton of iron is sufficient to reduce chill, control the uniformity of structure, and produce castings with excellent machinability.

SMZ alloy is a balanced inoculant containing 60 to 65 per cent silicon, 5 to 7 per cent manganese, and 5 to 7 per cent zirconium. Further information about the advantages of using SMZ alloy will be gladly furnished on request. The ELECTROMET office nearest you will be pleased to answer your inquiry.

The terms "Electromet" and "SMZ" are registered trade-marks of Union Carbide and Carbon Corporation.

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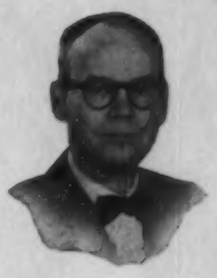


talk of the industry

BIG BITE out of the investment casting business is unlikely in the near future, but it's worth noting that International Nickel Co. is experimenting with electrodeposition of platinum and palladium for production of dentures. So far it's only in the lab stage. Also observed recently at Inco was equipment that permits non-destructive determination of composition by x-ray fluorescence. Suggests the possibility of 100 per cent inspection of critical parts. In the plating lab, electroless plating was being done – avoids corner buildup.

COOLING TOWER FOR MOLDS may be the way to delay shakeout in mechanized foundries where the conveyor is too short for adequate cooling time, and building doesn't lend itself to extending the conveyor or doubling back on the same or other level. Tower would be similar to a vertical core oven, Glenn Merrefield of Giffels & Vallet suggested on the way to the recent convention of the American Foundrymen's Society in Houston. Molds would be transferred to the tower from the horizontal conveyor, then back again after cooling in tower to safe shakeout temperature.

CAST CYLINDER HEADS on the Curtis-Wright Sapphire engines have been replaced by forgings. But castings didn't lose out entirely. Forged aluminum frames to hold the engine have been replaced by nodular iron cast to an accuracy of 0.02 in. American Brake Shoe Co. is doing it in Mahwah, N. J.

ACCIDENTAL INJURIES to workers during 1954 were lower than in any year since the 1930's despite an increase in total employment of one-third during the past 17 years and a nearly two-fold increase in physical output, according to the National Association of Manufacturers. Industrial safety records set last year are reflected in final reports from the U. S. Department of Labor, Bureau of Labor Statistics, which show that the over-all foundry frequency rate for 1954 was 17 per cent lower than in 1953. The castings industry is no longer mentioned as one of those that has a high accident frequency rate. Not perfect, but closer to perfection than ever before.

REAL METAL LOSS is often overlooked by non-ferrous foundrymen in calculating castings costs, E. W. Horlebein, Gibson & Kirk Co., pointed out during a luncheon conversation at the recent annual meeting of the Non-Ferrous Founders' Society. Instead of considering only the obvious, easily measured melting loss of several per cent, it is imperative to work on the basis of over-all losses of 12-15 per cent. This includes cleaning room losses due to sawing, cutting off, grinding to correct casting contour where large riser necks were required.

AIR FREIGHT RATE reduction of 20 per cent on castings flown east from the West and Pacific Northwest went into effect June 5. Points of origin affected are San Diego, Long Beach, Los Angeles, San Francisco, Oakland, Portland, Seattle, and Tacoma according to United Air Lines which requested the reduction.

CRUCIBLE SERVICE LIFE may be extended as a result of a National Bureau of Standards study of graphite (both flake and amorphous) oxidation

rates. Investigation of 20 graphites shows that coarser sizes having a graphitic content of about 85 per cent are difficult to oxidize either in air or in a stream of oxygen at 752 F. However, when fine and coarse sizes are combined, as in finished but unglazed crucible bodies, slow oxidation begins at 752 F, and the rate increases at higher temperatures with a definite deterioration of the body. Numerical constants for graphite oxidation rates in oxidizing atmospheres have been established. Because domestic graphite is not available in sufficient quantities to meet commercial requirements, foreign graphites were included in the study.

EVERY PRODUCT begins in the foundry according to a brochure recently made available to the castings industry and the public. One of the reasons was revealed recently by Beryllium Corp., Reading, Pa., in a report showing that cast beryllium copper forging dies for aircraft parts cut aircraft delivery time and slashed die costs by 75 per cent. Ultimate in economy is to remelt the die and cast another, meanwhile saving the pattern for possible future needs. The brochure on the castings industry? It's "The Foundry Is a GOOD Place to Work," just reissued by the American Foundrymen's Society in a larger, more pictorial form, complete with revised text.

SEGREGATION in alloys, unavoidable in relatively slow-cooled sections but usually not serious, is being encouraged by metallurgists in search of super-pure metals for research work. Zone refining, they call it. Idea is to melt a bar progressively from one end to the other with the impurities concentrating in the melt, leaving the pure, solid metal behind. For instance, iron prefers liquid to solid titanium. When an impure bar of titanium is melted progressively, the iron concentrates in the liquid titanium and follows the molten zone to the end of the bar which is then cut off. At the Westinghouse Research Laboratories, a square bar of titanium standing upright in a helium or argon atmosphere is slowly raised through a heating coil. High-frequency current (10,000 cycles) induces eddy currents in the bar, causing it to melt from the inside. The four corners, less affected by the induced currents, rapidly lose what heat they possess, and act as a cage for the molten metal. Zone refining also works on horizontal bars fluted by machined ridges which form the cage.

WILL SMOKE from proposed stacks dissipate into the atmosphere or come pouring down on nearby residents? Question can now be answered before stack is built using a method reported by Prof. R. H. Sherlock and E. J. Lesher, University of Michigan, in the January 1955 Transactions of the American Society of Mechanical Engineers. Behavior of gases from plant chimneys was studied in wind tunnel experiments. Operating factors were also studied. Under favorable conditions, light wind and high stack-gas velocity, for instance, smoke rises as it moves downwind and gradually disperses until the concentration is negligible. With strong winds and low stack-gas velocity, the gases may be forced downward relatively close to the plant. Using method described to compute necessary height and velocity for chimneys under weather conditions of proposed plant site, down-wash can be practically eliminated. Calculated gas patterns are related to the "basic plume" developed in the wind tunnel.

VIOLATING traditional non-ferrous melting rules such as "pour as soon as the metal is ready" and "don't use a charcoal cover" may become routine. In one shop they've discovered how to hold 85-5-5-5 at pouring temperature for 2½ days in a low frequency induction furnace under a charcoal cover. Castings come out without gas porosity. The well-known metallurgist who's doing this says he'll tell all at the 1956 Convention of the American Foundrymen's Society. Trick, he hints, is related to water of crystallization in the charcoal—and that's as far as he'll go for now.

Herbert P. Scobie

Issue A.S.T.M. Proceedings

The latest edition of *A.S.T.M. Proceedings*, a 1400-page volume recording the technical accomplishments of the American Society for Testing Materials for 1954, has been published. Leading the volume is the Summary of the Proceedings of the 57th Annual Meeting listing by title and author the program for each of the 36 sessions. The annual address by President L. C. Beard, Jr., entitled *"Plain Talk"* follows in which he speaks out against the breakdown in communications among scientists, engineers, and management urging a return to simple language which will make scientific matters clear to those with only a relatively elementary scientific background.

Reports of the 68 technical committees and their appendices provide a wealth of useful technical information as do the 37 technical papers and discussions on a wide variety of subjects pertaining to research and testing of materials. Copies of the book may be purchased from American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., at $12 per copy.

Compressed Air Power Film

"Compressed Air Power" is the title of a new 16-mm 17-min sound color motion picture produced by the Educational Committee of Compressed Air and Gas Institute, Cleveland. The film utilizes animation to explain graphically the compression principles of different types of compressors, also the operating principles involved.

The presentation begins with visual demonstration of the operation of the simplest and most familiar type of air compressor, the bicycle pump. This simple compressor is then visually converted to a basic power-driven compressor by replacing hand power with a conventional crank and flywheel. The film also covers displacement and dynamic compressors and concludes with animated explanation of compressed air power applied to linear action, air hammer, agitation of liquids, pressurizing and atomizing, and powering motors.

The film is available at a cost of $60 per projection print through the Educational Director, Compressed Air and Gas Institute, 1410 Terminal Tower, Cleveland, Ohio.

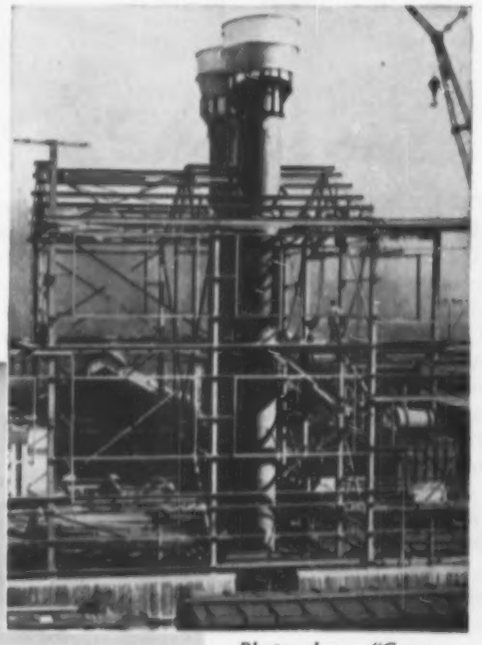
BUILT-IN ECONOMY

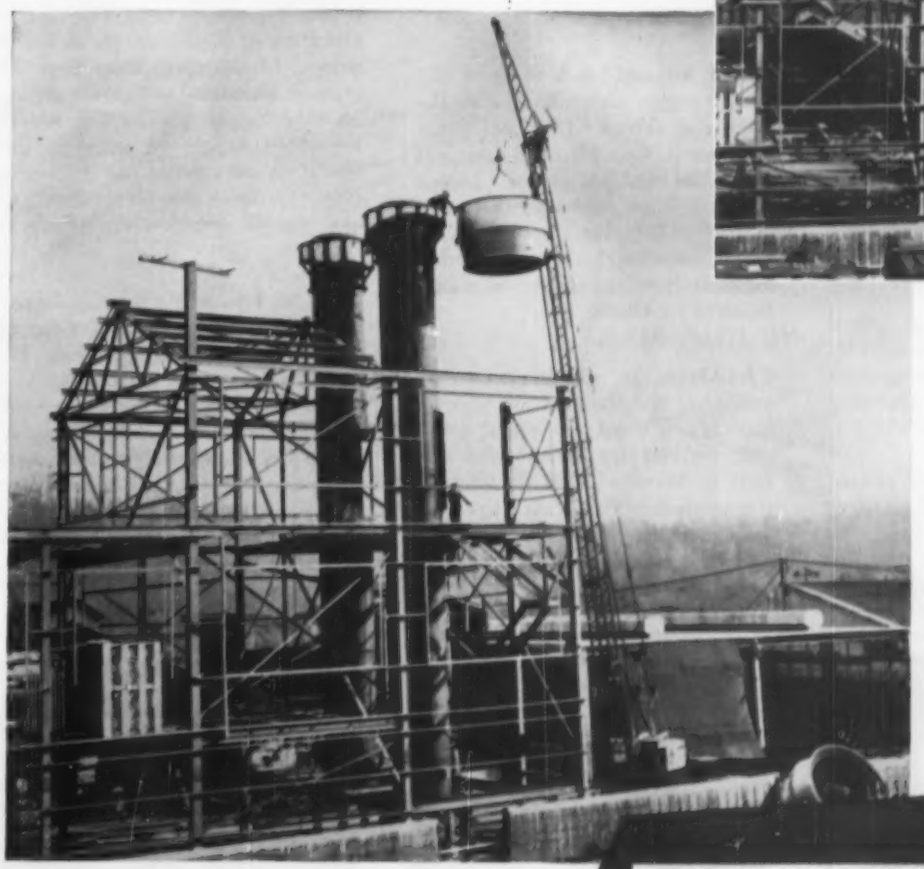
Like Lynchburg Foundry, you too, can save from the start by including Schneible Cupola Collectors in your plans RIGHT NOW!

The Lynchburg Foundry Company planned this new addition to save time and money. Installation of these Schneible Cupola Collectors was accomplished easily and economically with equipment already on the job for other structural work. No extra expense was necessary.

Further savings will be made from the start, because the Schneible Collectors will keep fly-ash and fumes from deteriorating roofs, gutters and other facilities thus extending the useful life of all original equipment.

Like Lynchburg, why not include Schneible "SW" Cupola Collectors and Multi-Wash Collectors in your plans and save right from the start.





Photos shown, "Courtesy of The Iron Worker, Lynchburg Foundry Company, Lynchburg, Virginia."

Cupola Collectors are "SW" type known throughout the industry as the most efficient and most economical wet method collectors available. Non-clogging distribution head, reuse of water and absence of moving parts mean practically no maintenance is required.

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For more facts, circle No. 87 on postage-free Reader Service card on p. 103 or 104

let's get personal

W. R. Jaeschke . . exchange author

R. E. Kennedy . . alumni secretary

Dr. J. E. Stareck has been appointed director of research of Metal & Thermit Corp., Detroit. In his new post he will also continue to direct the research activities of United Chromium, Inc., a subsidiary of Metal & Thermit. **H. H. McLeese,** formerly vice-president and general sales manager of United Chromium, Inc., has been appointed general sales manager of Metal & Thermit Corp.

Walter H. Girdler, Jr., a director of National Cylinder Gas Co., Chicago, has been elected a vice-president of the company; **Harold W. Alenduff** was elected treasurer.

Howard F. Kulas, Jr., has joined Cleveland Metal Abrasive Co., Cleveland, Ohio, in a management capacity with operating, technical and sales responsibility.

J. Douglas James has been elected vice-president and general manager of Urick Foundry Co., Erie, Pa. **Harold C. Boden** assumes new duties as production manager.

Wayne Belden has been elected president of Ajax Flexible Coupling Co., Inc., Westfield, N. Y. Other officers elected were: **Charles W. Belden,** vice-president; **Harley E. Northrop,** treasurer; and **Robert G. Cady,** secretary.

John J. Mlynski has been appointed central region sales manager for the Industrial Truck Div. of Clark Equipment Co. Mr. Mlynski will make his headquarters in Chicago and will have supervision of sales of the fork trucks, powered hand trucks, straddle carriers and other materials handling equipment manufactured by Clark.

Carl Mayer, Jr., who has been vice-president and general manager of Carl Mayer Corp., Cleveland, Ohio, will succeed his father, the late Carl F. Mayer, Sr., as president of the company. Mr. Mayer has been associated with his father in the operation of the industrial oven design firm for the past ten years.

Walter R. Jaeschke, consulting metallurgical engineer, Whiting Corp., Hammond, Ind., will write the official exchange paper from the American Foundrymen's Society to the Annual Meeting of the Institute of British Foundrymen in 1956. Since attending Armour Institute of Technology, he has spent more than 30 years in foundries, as foundry chemist, metallurgist, and melting supervisor. His experience included the operation of cupolas, air furnaces, rotary furnaces, side-blow converters and duplex combinations of these furnaces.

Drew M. Thorpe has been appointed executive vice-president of General Refractories Co., Philadelphia. He formerly served as a vice-president of the firm. Other executive appointments announced by the company were: **Lee A. Diehl,** from assistant secretary and assistant treasurer to vice-president and controller; and **George R. Rittenhouse** to assistant secretary and assistant treasurer, succeeding Mr. Diehl.

Robert E. Kennedy, secretary emeritus of the American Foundrymen's Society, was named permanent secretary of the AFS Alumni Group at the organization's annual convention in Houston, May 23-27. He replaces the late C. E. Hoyt, retired executive vice-president of the society, who had been secretary of the Alumni Group from its formation in July 1942 until his death January 29. Members of the Alumni Group are past officers and directors, gold medalists, and honorary life members of AFS.

S. David Tyler, formerly assistant general manager of the Foundry Div., Eaton Manufacturing Co., Vassar, Mich., has retired. Mr. Tyler learned the foundrymen's trade as a journeyman and patternmaker in Toledo, Ohio, and later owned and operated his own pattern shop in Detroit. He will make his permanent residence in St. Petersburg, Fla. **Paul Olson,** assistant plant manager at Eaton, will assume the responsibilities of Mr. Tyler as plant manager.

J. D. James . . Urick vice-president

H. C. Boden . . production manager

P. Olson . . Eaton plant manager

S. D Tyler . . retires from Eaton

A. Pirrie . . Standard vice-pres.

Alexander Pirrie has been appointed vice-president in charge of manufacturing of Standard Sanitary & Dominion Radiator Ltd., Toronto. **Theodore Tafel, Jr.**, will continue as vice-president.

J. A. Wettergreen . . Bucyrus v-p.

John A. Wettergreen has been elected vice-president in charge of manufacturing at Bucyrus-Erie Co., South Milwaukee. He had previously been general works manager in charge of manufacturing at all four domestic plants operated by the company.

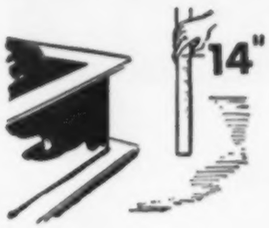
Carroll M. Baumgardner has been elected senior vice-president for sales of National-U. S. Radiator Corp., Johnstown, Pa. **Louis N. Hunter** was elected senior vice-president for engineering and research, and **Howard B. Steggall,** vice-president for manufacturing. **John C. Haas** and **F. M. Swartz** are vice-presidents for manufacturing; **Edmond J. Grady** is vice-president of the Pacific Steel Boiler Div.; **Marion I. Levy,** vice-president for the Viking Div., and **J. Roy**

continued on page 26

Shake out

NON-PRODUCTIVE SAND HANDLING COSTS!

LOW HEAD ROOM

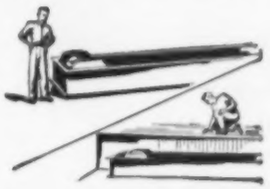


Space is saved and installation under floor or overhead is made easy by low height averaging less than 14" except where shaker is mounted.

FOR SHORT OR LONG CARRIES

Ajax Lo-Veyors are made in lengths from 3 ft. up. They can be used for short "feeder" runs and for long carries with two or more units in series.

EASILY INSTALLED



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Drive unit is sealed in oil-tight case. No exposed bearings subject to damage under abrasive conditions. Long life and low maintenance cost assured.

Today the most economical way to make substantial savings is to cut material handling costs. Fast, uninterrupted production flow of materials between departments and between machines eliminates unscheduled down time of expensive machines and skilled operators.

Ajax Lo-Veyors are perfectly simple and simply perfect for foundry conditions. The principle of design and construction of Ajax Lo-Veyors contributes to low power requirements. The reciprocating drive is in automatic balance. Entire conveyor pan and drive floats on springs and is not dependent on heavy anchorage to building for application of drive force. Materials can be scaled or sized while being conveyed. Thus, one Ajax Lo-Veyor performs two operations which ordinarily require two machines.

Ajax Lo-Veyors answer the exacting requirements of modern industry. Their performance record in thousands of installations, large and small, is proof of their adaptability and economy. They are made in a wide range of lengths, widths and capacities to fit every condition. Write for Ajax Lo-Veyor Bulletin No. 39.

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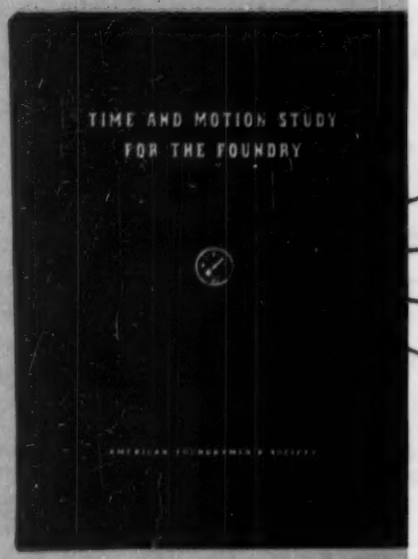

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continued from page 25

Knox, vice-president for the heating and air conditioning division. **Ralph W. Bolsinger** has been elected secretary; **John G. dePass,** assistant secretary, and **B. C. Straub,** comptroller. **L. L. Hotsenpiller** has been named executive assistant to the president.

P. E. Rentschler . . state appointee

Peter E. Rentschler, president, Hamilton Foundry & Machine Co., Hamilton, Ohio, has been appointed a member of the Ohio State Conference Committee on Education to report to the White House Conference this fall. The committee was organized to bring together educators and other interested citizens to discuss educational problems in the state and make recommendations for appropriate action to be taken at local, state and federal levels.

R. R. Deas, Jr., . . Hamilton v-p.

Richard R. Deas, Jr., works manager of Hamilton Foundry & Machine Co., Hamilton, Ohio, has been elected to a newly created office of vice-president and will serve as vice-president and works manager.

F. W. Glaser . . Alloy director

Frank W. Glaser has been appointed a vice-president and director of Alloy Precision Castings Co., Cleveland. In his new post, Glaser will be in charge of new development work, engineering and production operations. Alloy Precision, a licensee of Mercast Corp., New York, produces a wide range of precision parts made by the frozen mercury process of investment casting.

E. C. Kron . . division metallurgist

Ernest C. Kron, formerly steel metallurgist for the Doehler-Jarvis Div., National Lead Co., has been promoted to division metallurgist. Mr. Kron, who joined Doehler-Jarvis in 1947, succeeds **J. C. Fox,** who left Doehler-Jarvis in January to open his own consulting office.

Lars Torn, engineer at the Karhula Works of A. Ahlstrom Oy, Karhula, Finland, is on a 5½-month tour of United States foundries studying steel casting practice. On his way back to Finland he will spend three months investigating techniques in England and Germany. Ahlstrom, one of the largest companies in Fin-

continued on page 28

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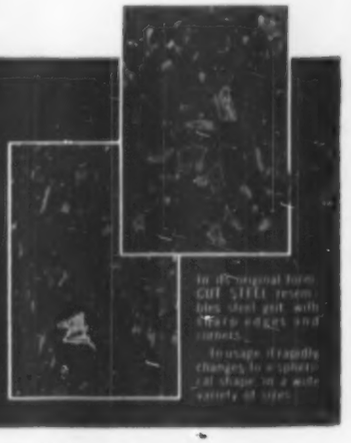

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continued from page 27

land, makes paper mill, mining, and ore processing equipment, and operates a number of plants including a glass works, sawmill and wood products works, pulp and paper mill, and a chemical plant.

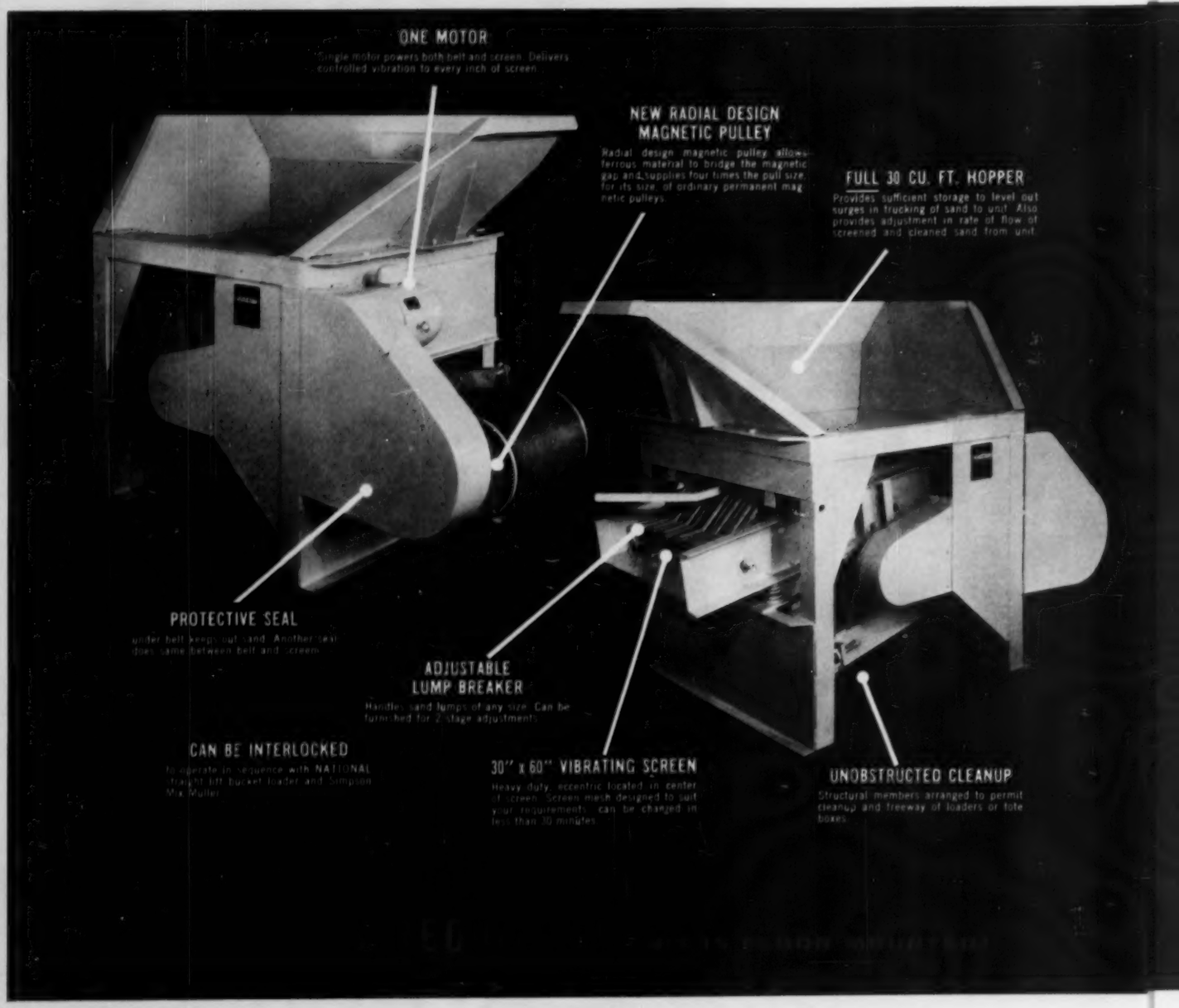
J. Bermingham . . sales manager

John Bermingham, formerly sales representative, has been appointed Western sales manager for E. F. Houghton & Co., Philadelphia. His headquarters will continue to be located at Houghton's West Coast Plant in San Francisco. Mr. Bermingham is chairman of the Northern California Chapter.

A. H. Siereveld . . employee director

Adrian H. Siereveld has been appointed director of employee relations of Hamilton Foundry & Machine Co., Hamilton, Ohio. In this position Mr. Siereveld will have charge of all functions of the personnel department, which includes employment, safety and hygiene, first aid, plant protection, and employee relations. **Eldon M. Altman** will continue as personnel director and safety director, and **Clarence W. Rowsey** will remain employment manager.

NATIONAL SCREEN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Handles sand lumps of any size. Can be furnished for 2 stage adjustments.
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Heavy duty, eccentric located in center of screen. Screen mesh designed to suit your requirements... can be changed in less than 10 minutes.
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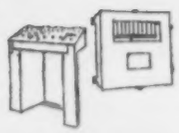

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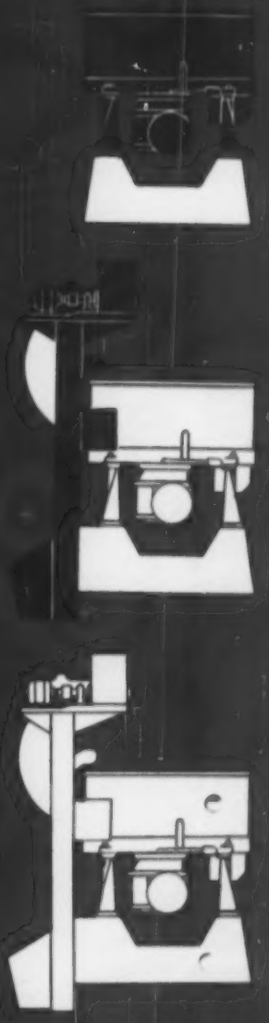

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L. C. Hewitt . . director of research

L. C. Hewitt, formerly with Laclede-Christy Co., St. Louis, has been appointed to the staff of Ironton Fire Brick Co., Ironton, Ohio, as director of research.

H. M. St. John . . retires from Crane

Harry M. St. John, superintendent of non-ferrous foundries, Crane Co., has retired. He will make his permanent residence at Fort Pierce, Fla., and expects to continue his foundry interests as a consultant. A chemical engineering graduate of 1910 from Cornell University, he has been with Crane since 1938, starting out as superintendent of the Brass Foundry and Forge Shop. His American Foundrymen's Society activities have included chairmanships of the Annual Lecture Committee and Publications Committee, membership on numerous other committees, and chairmanship of the Brass & Bronze Div. He is currently on three Brass & Bronze committees. In 1947 he was awarded the AFS Wm. H. McFadden Gold Medal.

Dr. Augustus B. Kinzel has been elected vice-president in charge of research of Union Carbide & Carbon

continued on page 30

FOUNDREZ 7600...

for flexibility in meeting special core production problems

● Using FOUNDREZ 7600 as their sand binder, many of our customers are making the core mix that's just right for their particular casting metal, oven capacity and production rate.

This liquid water-soluble thermosetting urea-formaldehyde resin permits the widest variation of core properties. It enables you to adjust green strength, collapsibility, permeability, hardness. Thus, you can produce the core that's best for the metal you're casting . . . copper, brass, bronze, aluminum, magnesium, gray iron, cast iron, steel alloys.

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For full data at no obligation, write for Technical Bulletin F-2. RCI's Foundry Technical Service is available to help create the mix most suited to your purpose.

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REICHHOLD CHEMICALS, INC., RCI BUILDING, WHITE PLAINS, N.Y.

For more facts, circle No. 90 on postage-free Reader Service card on p. 103 or 104

continued from page 29

Corp., New York. Dr. Kinzel has been actively engaged in research work with UCC since 1926, when he joined Electro Metallurgical Co. as a research metallurgist.

R. O. Schiebel . . Magnaflux sales mgr.

Roy O. Schiebel has been made sales manager of Magnaflux Corp., Chicago. **Robert G. Strother,** formerly Western manager in Los Angeles, will be the new Eastern manager. **Kermit A. Skeie,** Chicago manager, will move to Los Angeles as Western Region manager, and the new manager of the Central Region in Chicago will be **Denis P. Walsh.**

F. Biggs . . Brake Shoe chairman

Fred Biggs has been named division chairman of the Brake Shoe & Castings Div., American Brake Shoe Co., New York. Appointed to fill the vacancy of division president and chief executive officer is **Stephen S. Conway,** formerly first vice-president in charge of sales. Moving up to sales vice-president for the division is **John F. Ducey, Jr.,** and named to the new post of division vice-president in charge of railroad sales is **Sam R. Watkins.**

H. C. Platt . . Division president

Harry C. Platt has been appointed president of the Engineered Castings Div., American Brake Shoe Co. He succeeds **N. G. Belury,** who was recently appointed sales vice-president for the company. Mr. Platt was formerly vice-president in charge of production for the Engineered Castings Div.

A. J. Buckley . . sales manager

Arthur J. Buckley, formerly assistant sales manager of Pangborn Corp., Hagerstown, Md., has been promoted to sales manager. He has served as assistant sales manager of the corporation since 1952 when he joined Pangborn after many years of sales work with Harnischfeger Corp., Milwaukee.

Walter R. Fry, formerly superintendent and consultant of Guilford Foundry Co., Greensboro, N. C., has been appointed general superintendent of Slinger Foundry, Slinger, Wis. **Fred A. Grover,** purchasing agent for Slinger, has been named secretary.

continued on page 114

Original Cost of Flasks
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= Actual Cost of Flasks!

...and you can bank on Sterling ECONOMY ALWAYS!

Because they LAST LONGER STERLING FLASKS COST LESS

No foundry ever "babies" its foundry flasks. Rough treatment is all they get. They've got to be able to take it . . . or out they go! Sterling Steel Flasks withstand routine foundry abuse for years . . . so, in the long run, they are the most economical. Their famous *Rolled Steel Channel* construction gives them strength and rigidity to withstand the tremendous pressures of molding, year after year. Their all-welded construction, rugged reinforcing ribs, square flanges, machined partings, full width bearing are time-honored features that have won the respect of foundrymen for Sterling Flasks. Treat 'em rough, they won't "let you down" . . . and for economy, you can't beat 'em!

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HOW TO BAKE CORES WITHOUT HEAT

DR. WALDEMAR SCHUMACHER / *General Manager*
Concordiahutte, Bendorf am Rhine, Germany

CARBON DIOXIDE BLOWN THROUGH A WATER GLASS, SAND MIXTURE WILL BOND THEM IN MINUTES.

■ Binders are a major expense in any foundry. The carbon dioxide process makes possible not only considerable savings in these costs, but provides technological advantages as well.

Since the CO_2 process was first outlined to American Foundrymen (H. J. Heine, "Carbon Dioxide Core 'Baking'," AMERICAN FOUNDRYMAN, vol. 26, no. 5, Sept. 1954, pp. 46-49) much additional work has been done in Germany. The author hopes that this further information will aid foundrymen in experimenting with this new method in their plants.

The process itself depends upon the formation of a gel (silicic acid) which is set free when carbon dioxide reacts with sodium silicate (water glass). Sodium carbonate is also formed during the reaction. Silicic acid forms a skeleton around the sand grains and strongly binds them together. Sands designed for steel, gray iron, and all non-ferrous metals may be used.

The sand mixture is made by blending a fine-grained, dried river sand with 4 to 5 percent of a special binder (water glass). Depending upon the material to be cast, different materials are added to this basic mixture as extenders: In Germany, 1 per cent asphalt binder is used in steel, while 4 per cent sea coal is used in gray iron practice. Wood flour may be substituted for the sea coal. The purpose of these additives is to increase collapsibility of core or mold by burning out when the liquid metal enters the mold. A fire clay grog is sometimes added to the basic formula for thicker-walled castings. The sand is mixed in an ordinary mixer for four to six minutes and is ready for immediate use.

Figure 1 shows how the cores are prepared. The core box is packed by either ramming or jolting—omitting many of the reinforcing rods and wires. A hole about ¼ in. in diameter is next pushed through the green core for the purpose of introducing the CO_2 gas under about 30 psi pressure for about 15 to 20 seconds. As this gas permeates the core, the core is completely hardened and may be removed from the core box in one piece.

The hardened core may be coated with a core wash or not (depending upon its intended use), placed in the mold, and cast. Washed cores are not necessarily dried before use.

The author refers to cores made by the CO_2 process.

Once the sand is mixed, it is best kept either in a container or covered, i.e., during the night, with wet burlap because the CO_2 in the air causes a crust to form over the sand if it is not protected.

Once the molds or cores have been treated with carbon dioxide, they are quite stable and not hygroscopic. They can be stored almost indefinitely.

In preparing molds, the special sand mixture is used as a facing. About 2 to 3 in. of the sand is placed over the pattern and rammed lightly. Backing sand fills in the remainder of the flask, and the sand is rammed in the usual manner either by hand or in any of the available types of machines. After

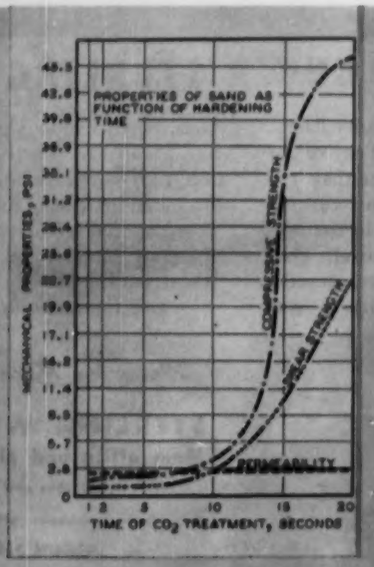


Fig. 2 . . Physical properties of water-glass bonded sands.

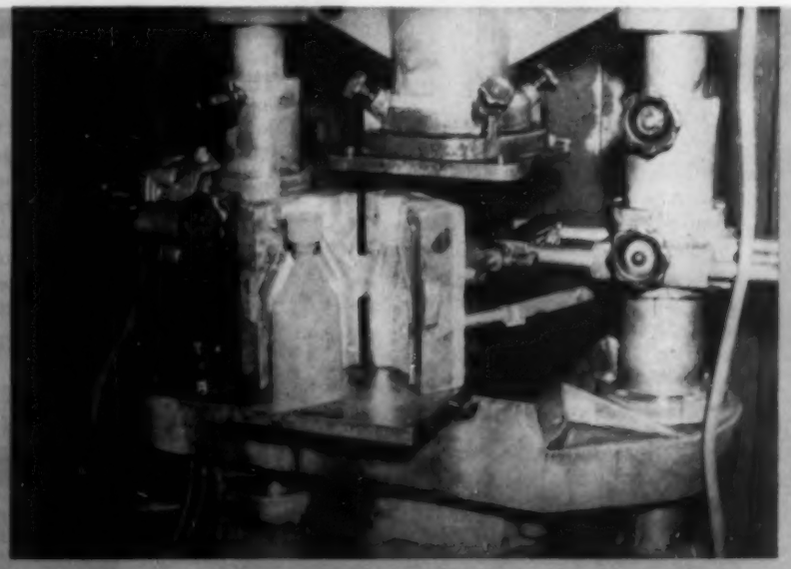


Fig. 3 . . Conventionally blown core was hardened in core box with 15-sec. application of CO_2; driers are eliminated and core rods reduced.

Fig. 1 . . A ¼-in. hole is punched through the green sand mold or core to allow CO_2 gas under about 30 psi pressure to permeate the sand and set-up the water-glass binder.

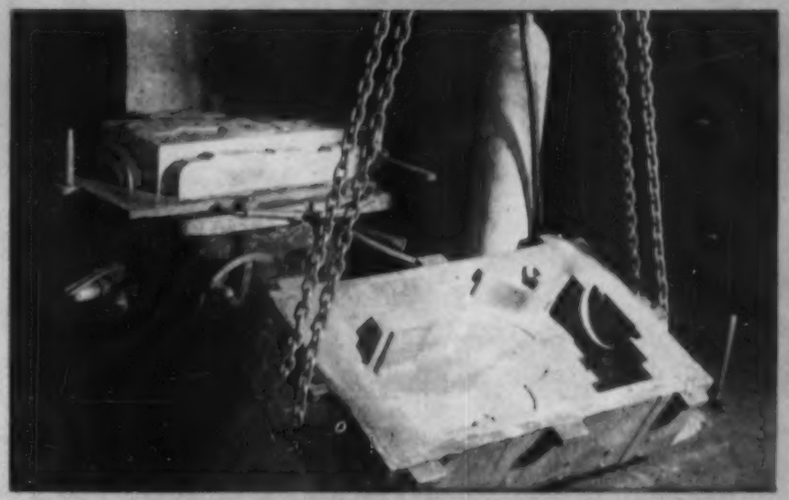


Fig. 4 . . Green sand mold, conventionally faced and backed and jolted, is removed after hardening with CO_2 passed through vents in pattern.

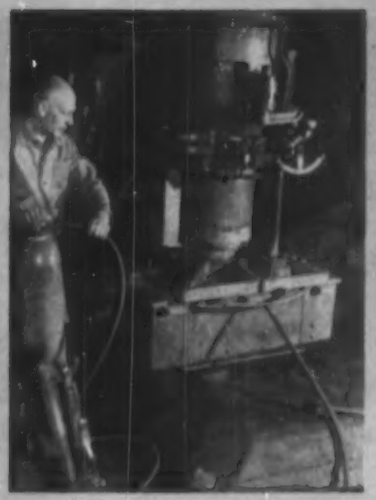


Fig. 5 . . Molder admits CO_2 before drawing the pattern.

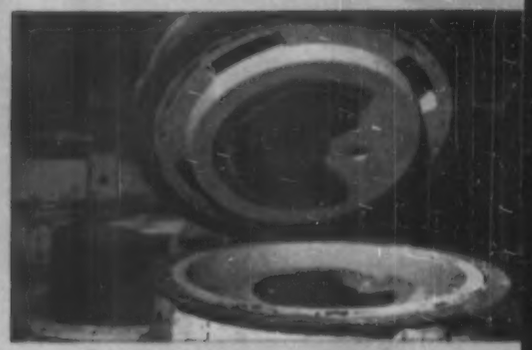


Fig. 6 . . Inner core and cope flask for street roller shell.

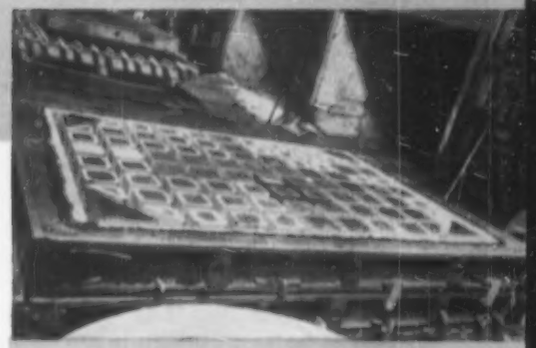


Fig. 7 . . Large mold was blown with CO_2, coated with zircon wash.

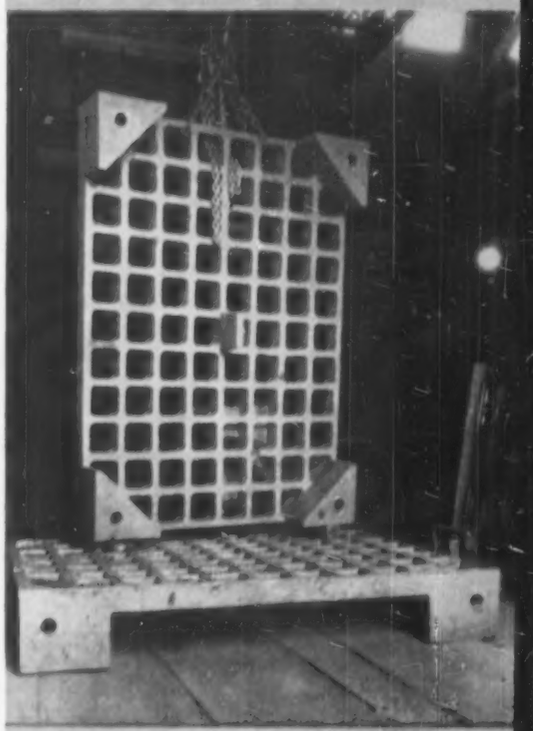


Fig. 8 . . 5-ton casting from above mold; oven drying was eliminated.

this, about 15 to 20 holes are equidistantly placed in the mold, and the CO_2 gas introduced into them.

Of course, the sprue, runners, and ingates must all be part of the pattern, since the sand is hardened in place prior to pattern removal. Gating and risering techniques need not be modified.

Evidence has shown that the heat conductivity of this type of sand mixture is less than that of a normal composition. Therefore, the metal stays liquid in the mold longer than would ordinarily be expected; however, regular pouring procedures are used.

Figure 2 gives an idea of the physical properties of the sand bonded by this process. Notice that during the first few seconds of CO_2 application no appreciable shear or compressive strength is produced; but after 5 seconds exposure, values begin to increase until after 20 seconds the sand mixture is as strong as dried sand. Permeability appears to remain constant.

The CO_2 process may be used with regular foundry molding and coremaking methods. Hand ramming has been illustrated, but core blowing can also be used. Figure 3 shows the preparation of a blown plug core for a gray iron housing. After the core was formed, CO_2 was blown through it for 15 seconds, hardening it for immediate use. Core rods have been practically eliminated and no core driers are necessary.

Figure 4 shows a mold removed from the pattern after about ¾-in. facing sand and backing sand have been added in the usual manner, after conventional jolt ramming, followed by hardening with CO_2. The gas is introduced into the green sand mold through the piping at the near edge of the pattern plate and through vents in the pattern surfaces. Figure 5 shows molding machine position as the operator operates gas valve.

Figure 6 shows a set-up for the shell of a street roller (the inner core and the cope flask). The casting is made of steel and the blow-holes are located near the upper edge, equidistantly spaced about ¾ in. from the surface. The CO_2 is blown all the way down and also into the core; and after the blowing and hardening, a zircon wash is applied and allowed to "set" for about 5 hr before assembling and casting.

Figure 7 shows a mold for a steel casting weighing five tons. The whole piece was made by the CO_2 process—all the parts were blown, the mold zircon washed, the cope put in place, and the part cast. No oven drying was necessary. Figure 8 shows the finished casting made in the mold.

Figure 9 shows still more parts produced by this process. One piece weighs about six long tons and the cores and outer parts of the mold were hardened with CO_2. The lower part of the mold shows the vents which serve to remove the air from the core. The cracking strips indicate it is a steel casting.

Figure 10 shows the completed casting which weighs about six long tons, including sprue, gates, and risers.

What are the advantages of the CO_2 process? Figure 11 shows the mold and the core of a jacket for rolls, both of which were made by this process. All of the factors which led to economies will be explained.

CO_2 Process Movie Available

Motion picture showing core and mold production with carbon dioxide and water glass as binders is available from American Foundrymen's Society. A 16-mm black and white film running approximately 15 minutes, the movie depicts German practice but all descriptions are in English. For rental details and bookings, write: Hans J. Heine, Technical Director, American Foundrymen's Society, Golf & Wolf Roads, Des Plaines, Ill.

Fig. 9 . . CO_2 hardened mold.

Fig. 10 . . Rough steel casting from Fig. 9 mold.

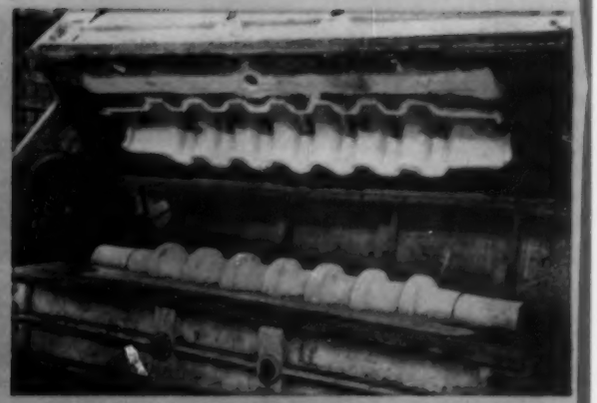


Fig. 11 . . Mold and core for roll jacket

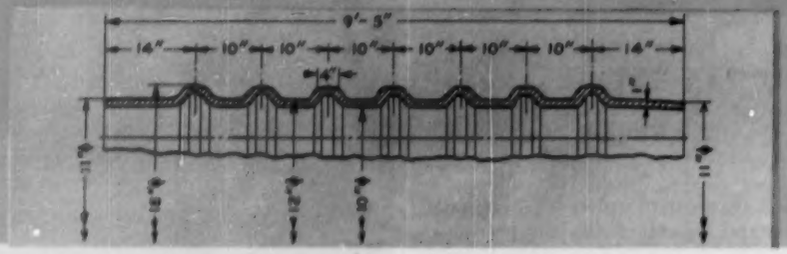


Fig. 12 . . Production time for making roll jacket was reduced from 1000 minutes for the old process to 840 minutes with CO_2 process.

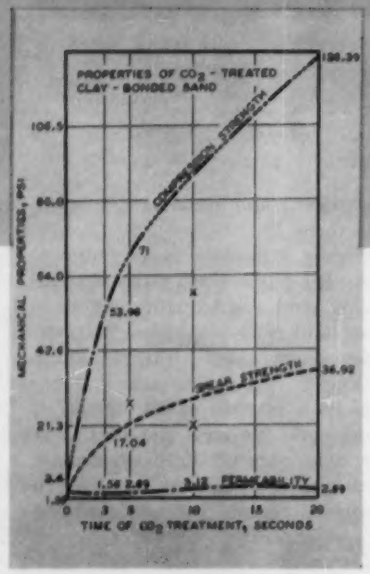


Fig. 13 . . Newly formulated mix allows removal before hardening.

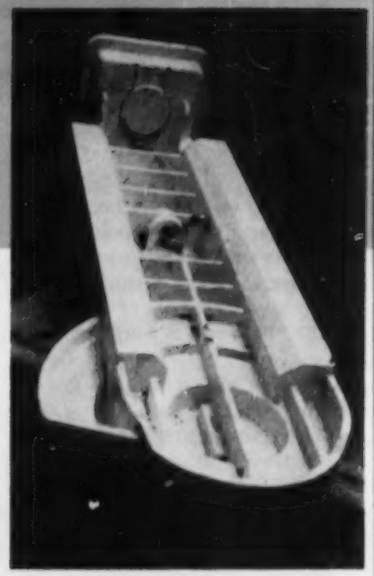


Fig. 14 . . Pattern for a 1100-lb bed casting contains many ribs.

hütte remodeling the conventional Note that the sprue was made from a wooden pattern; the gates are not shown.

Figure 12 shows the drawing of this roll jacket. This part is 7½ ft long and 1 ft in diameter. Both the old and new processes are compared. The old process required 1000 minutes production time, the CO_2 process only 840 minutes.

As for some of the additional costs, CO_2 must be blown into the molds, and it takes 35 minutes for the cope and drag combined. By using a compressor, blowing time may be reduced. However, there is no necessity for reinforcements, and fewer gaggers are needed. About 15 minutes is saved because of this. The cope need not be turned, eliminating plates. The pattern can be removed from the mold immediately after hardening. No drying or core baking are necessary, eliminating much handling and transporting.

The 160 minutes saved doesn't even count the time for transporting the cores and molds to the drying ovens and the pouring area.

The steel foundry of Concordiahütte in Bendorf uses this process exclusively in their coremaking department. They discovered that the labor cost per long ton of good castings shipped was the lowest in any German steel casting plant. This can be attributed to the elimination of many operations and the speeding up of the core cycle.

As for the molds in this shop, about 60 per cent are prepared by the CO_2 process, and the remainder made by usual synthetic sand practices or by sweep molding.

All size castings, from 65 pounds to 7 (long) tons, are produced here. The average hourly output of the molders was raised from about 120 lb to about 135 lb. To express it differently, the wages per operator dropped from $7.80 per long ton to $7.00 per long ton—an increase in productivity of nearly 15 per cent.

Cost Is Low

In Germany, the binders used for the CO_2 process are always cheaper than drying oil binders available in core rooms. Furthermore, this CO_2 binder is always available in any country where a chemical industry exists. There is hardly any fluctuation in the price of the sodium silicate or CO_2.

At the steel foundry of Concordia-drying ovens to permit more air circulation to take care of spot demands for more molds and cores was considered. After introducing the CO_2 process, this factor could be ignored. Now the ovens are used only for drying sweep molds. This elimination of oven drying has the added advantage that the flasks are no longer exposed to the oven gases, and therefore, stand up longer due to the decreased wear and tear.

Since the molds and cores can be hardened rapidly, castings can be speedily made, and should a large core break, another can be made in a hurry while the heat is still being poured. This, in turn, assures on-time delivery to the customer.

As mentioned before, the patterns are withdrawn from the mold after the sand hardens. The core boxes are also taken apart after the core hardens. The patterns and core boxes are never forced or rapped; therefore, both the core and mold are always accurate dimensionally. Casting precision is simply a question of figuring the shrinkage correctly and properly preparing the pattern. This also makes possible the specification of much smaller machining allowances.

There is no need for slicking the mold. No oven baking is necessary, nor are core driers.

In referring to the manufacture of the steel rolls, the few steps necessary to produce the core and molds were described. With fewer steps

Fig. 15 . . Sprue is cut after the pattern has been removed.

Fig. 16 . . Molder blows CO_2 into a section of the mold.

than in normal practice, there is less chance to make mistakes, and scrap drops. At a foundry in the Rhine Province, it has been shown that the introduction of the CO_2 process reduced scrap.

Core Hardened in Box

For the roll jacket, only one-half of a core box is necessary to make the core, because the core is hardened directly in the box and the same box can be used for both halves. This means that for symmetrical molds, only half a box is necessary for the CO_2 process, whereas with drying oil 24 hr of curing time for each half is not uncommon, followed by pasting and drying to form a cylindrical core.

As for some of the difficulties encountered with the process, of course, the patterns must be perfect, especially with respect to draft since the sand is hardened directly on them. Also, it is best to use this process for the manufacture of parts that are symmetrical and have no large vertical planes. Concordiahütte has tried to overcome this limitation in the steel foundry by developing a modified process. According to this, the pattern is first removed from the mold and the mold then hardened.

The old sand mixture had low strength values which started to increase only after five seconds. By using the modified process, 1.5 psi shear strength and 5.3 psi compression is obtained immediately after blending. This permits immediate removal from the pattern without prehardening. (Fig. 13).

Figure 14 shows a pattern for a bed with a lot of ribs. The part weighs 1100 lb. In Fig. 15, the pattern has already been removed from the mold, and the molder is cutting the sprue instead of having it as part of the pattern. He begins to blow CO_2 in Fig. 16.

This modification now makes it possible to use all types of patterns with the CO_2 process.

Soda Ash Lowers Sintering Point

Since the hardened sand contains soda ash, the problem of reused sand deserves careful consideration. Soda ash lowers the sintering point of silica, thus the used CO_2 sand should not be mixed with green sand. The used sand should be allowed to be exposed to air and leached of soda ash by rain—or it must be used with old backing sand.

The author has tried to present a report on the CO_2 process. That this process has taken hold in Germany may be seen from the sales of one CO_2 producer for the German foundry industry. In 1953, he delivered about one ton of CO_2 in three months; today he sells about 70 tons during the same period.

The CO_2 process must be used with discretion—it is not a panacea for the foundryman. One can't use sweep molding with the CO_2 process. However, each foundry utilizes a number of patterns where it is feasible to take advantage of the economical and technological improvements that are afforded by this process.

Do not hesitate to try out this process, despite the usual difficulties which are encountered with anything new. Don't give up right away; perseverance is worthwhile.

The author gratefully acknowledges the invaluable assistance of O. Jay Myers, technical director, Foundry Products Div., Archer-Daniels-Midland Co., Minneapolis, and Hans J. Heine, technical director, American Foundrymen's Society, Des Plaines, Ill., in translating and critically appraising this manuscript.

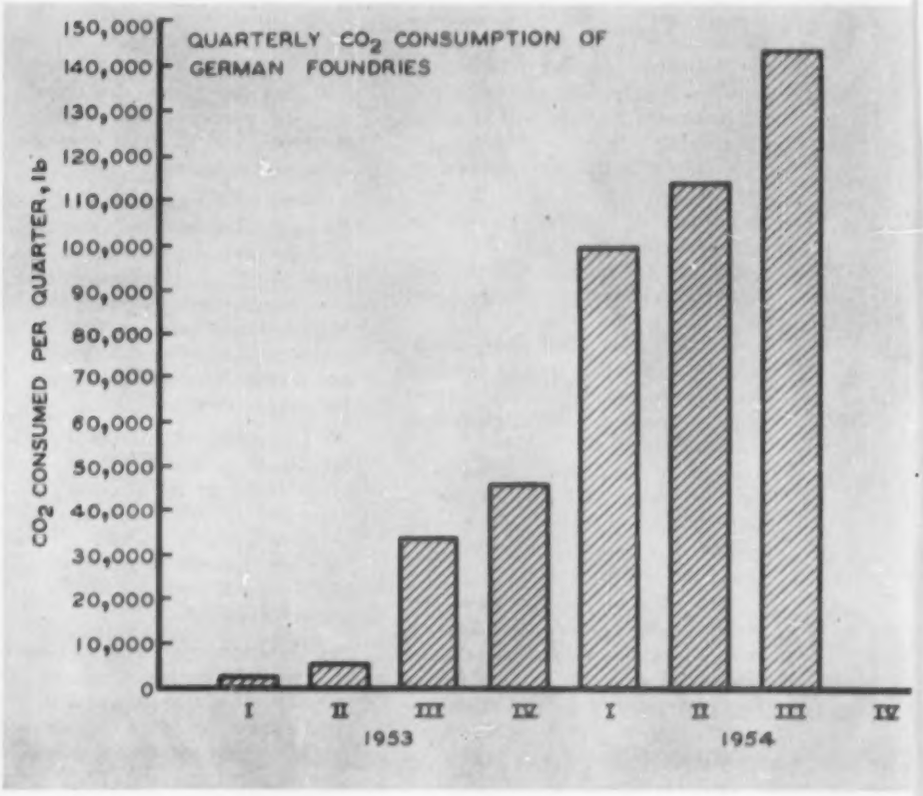


Fig. 17 . . Use of CO_2 in German foundries has increased rapidly.

" . . . It is high time foundry executives intensify their human relations activities to counteract the union purpose of restricting relations with our employees. . ."

" . . . Let me quote from O. A. Ohmann in the May-June issue of Harvard Business Review. . ."

" . . . Each individual should have an opportunity to develop the maximum potential of his skills. . ."

Human Relations

This isn't a philanthropic idea; it pays off in efficiency and worker morale

■ Many forces are working to drive a wedge between the front office and the foundry. They would substitute for intimate personal relationships between management and employees a protest-and-pressure type of group relationship.

A very astute public relations expert said to me not long ago, "Industry has not competed successfully with the politician and the labor leader for the interest and the soul and the loyalty of the average worker."

It is high time that foundry executives intensify their human relations activities to counteract the avowed union purpose of restricting relations with our employees.

Recently I addressed a letter to 43 personal friends in the foundry industry who are presidents or general managers of plants. This is the question I put to them:

"What policy, plan, program, procedure, method or technique has contributed most to good employee relations in your plant and has helped best to develop high morale, cooperation, loyalty, sympathetic understanding, dependability, efficiency, high productivity and individual incentive among your hourly workers and salaried people?"

■ **Company character.** There was almost unanimous agreement as to the number one ingredient. It is company character. By that I mean the attitudes, the ideals, the objectives and the integrity that characterize the record and the reputation of the company management.

In the May-June issue of *Harvard Business Review* there appears a thought-provoking article on "Skyhooks" by O. A. Ohmann, in charge of management development with the Standard Oil Company of Ohio. Mr. Ohmann describes the philosophy of one extremely successful executive of his acquaintance.

"This executive assumes that each individual possesses certain God-given rights of self-direction which only the individual can voluntarily delegate to others in authority over him and that this is usually done in the interest of achieving some mutual cooperative good.

"The executive therefore assumes that his own authority as boss over others must be exercised with due regard for the attendant obligations to his employees and to the stockholders who have temporarily and voluntarily yielded their rights in the interest of this common undertaking.

■ **Personal recognition.** Rated second and almost equal to company character as essential to the success of a human relations program was personal recognition.

Whiting Williams, the author of "What Makes Us Humans Tick" and a labor relations expert, contends that the average industrial worker seeks, above all else, recognition of his dignity as an individual and of his importance as a member of an organization or production team.

The satisfaction a worker gets from such a feeling of recognition and importance transcends even his desires for job security and good wages which rank next on Mr. Williams' list of worker motivations.

The suggestion box plan often defeats its useful purpose when suggestions are too impractical. When the employee making the suggestion is given a rejection slip or a reward he considers inadequate, he accepts it as a rebuff—the very antithesis of desirable personal recognition.

By tieing in the suggestion box idea with a program of work simplification and changing the name to "Improvement Proposal Plan," we at Texas Foundries have devised an effective plan of personal recognition and financial award.

During and following their participation in work simplification courses, employees are motivated to analyze critically their equipment, work stations, and their production procedures by the so-called "Why" method. They are taught how to prepare flow process charts and multiple activity charts; to break down each step and each movement into minute operational detail which reveals opportunities for improvement in equipment or method.

Their proposal for improvement is discussed with foreman and the work simplification engineer. Technical advice and mechanical assistance is provided to develop the idea into a project proposal which the employee himself evaluates by applying a formula of costs and savings.

As his project proposal is processed, the employee himself either proves or disproves its practicability and works out a monetary value.

■ **Continuous communications.** Rat-

" . . . The dual objective is increasing productivity and maximizing self-development. . ."

" . . . It can best be achieved by giving employees opportunity to exercise their capacity."

" . . . Profits are regarded as a measure of the group's progress toward these goals. . ."

"Tom Girdler said: 'I try to be fair. I try to be sure I have been fair. Then I'm damn tough.' "

in the Foundry

ed third in the list of essentials was continuous communications.

Communications must be carried on continuously and must work both ways—down from top management to all levels and up from the humblest unskilled laborer to the man in supreme authority.

There can be no more effective means of communication than face-to-face verbal contact. I suggest that every foundry executive circulate as much as possible through the plant and make it a point to speak cheerfully to every man he passes, calling him by name if possible. That is the most human of all human relations.

Most Human of Relations

Some companies shy away from mass meetings but the courts have upheld the right of an employer to address his employees en masse where there is no coercion or other violation of the Taft-Hartley law. A plant-wide meeting on a voluntary basis with pay for the time involved will provide a golden opportunity for a foundry executive to keep all his people thoroughly and uniformly informed about important human relations matters.

One of the most articulate and powerful mediums we have is that of company publications. There exists a great opportunity in the editorial policy and the content of many company publications which becomes more strikingly apparent when a comparison is made with similar publications put out by the unions.

■ **Selection, assignment, training.** Number four on the list of elements most frequently referred to in the replies received can be grouped under the general heading: selection, assignment, training.

After hiring comes the problem of assigning and orienting new employees so as to fit the "round pegs in the round holes and the square pegs in the square holes." One company I know of is solving this problem with steadily improving results by the use of psychological aptitude and placement tests.

In selecting management staff people or upgrading and promotion within a company line organization it is desirable to have a group of candidates screened from those whose original test records show them to be the most promising.

The cost of installing a program of psychological testing is modest when compared with the cost of turnover caused by careless or faulty selection, assignment, orientation, upgrading, and promotion.

Another technique of assignment and orientation also embraces certain aspects of communications.

After our own personnel department has screened and selected the most promising applicant for a job vacancy, the foreman concerned is given the opportunity to accept or reject the man selected. When a final selection has been agreed upon, a date is made for the foreman to visit the home of the new employee during off-duty hours.

The foreman takes with him the employee booklet and other pertinent printed and illustrated material and explains fully to the new employee, and particularly to his wife, all matters of company personnel policy, job requirements, incentive pay procedures, group insurance, medical service, vacations, and any other matters that will be of interest and importance to the new employee and his family. Such a meeting on the home grounds establishes a personal and sympathetic understanding.

Incentive compensation also offers one of the most fruitful fields for building a sound and equitable foundation for good human relations.

At Texas Foundries we have developed a novel type of incentive compensation for production management people which we call the "Cost Reduction Incentive Plan." It has worked so well for us that for each of the past two years we have been able to attribute to it savings in operating costs running well up into six figures.

Here is the way it works. At the beginning of the year an operating budget is prepared for each cost center, with fixed and variable allowances determined by volume of work. Thus is established a standard or "par" for performance.

Each week a flexible budget report with an itemized statement of allowable and of actual costs is furnished to the foreman, supervisor, and department head responsible for the operation of each cost center.

The percentage of saving in actual costs shown by this flexible budget is used to determine half of the incentive bonus paid at the end of each quarter. The other half is determined by the percentage of savings for the combined operations of all cost centers to make up a plant total.

Thus, if the coreroom cost center showed a saving of 10 per cent and the combined total plant savings were 8 per cent, the coreroom foreman would receive a cost reduction bonus of 18 per cent of his quarterly salary.

If any cost center fails to show a cost reduction, no quarterly bonus is paid to the management staff people concerned and if there is no cost reduction for the total plant, no bonuses at all are paid for that particular quarter.

During 1953 the incentive bonuses paid under this plan amounted to an average of 19.96 per cent of the annual salaries of the participants and for 1954 this percentage figure was 13.7 per cent.

We feel that both the company and the management staff people concerned profited greatly from the plan, both in dollars and cents and in improved human relations.

This article is excerpted from a speech by C. C. Chambers, president, Texas Foundries, Inc., at the Alumni Dinner of the American Foundrymen's Society annual convention last May in Houston, Tex.

Casting High Quality Magnesium

a new look at every phase of production and testing for better magnesium foundry practice

■ Sand casting practices for magnesium are similar to those for other metals. But there are differences and unusual features, and in explaining these it may seem magnesium alloys have limited castability. On the contrary, in no metal have commercial castings of greater complexity been cast to higher quality standards than in magnesium alloys. The tremendous program of improving the performance of military aircraft over the past ten years has made use of the excellent castability of the ultra-light magnesium alloys to stringent quality standards.

To help achieve the high quality standards that have been demanded in magnesium castings for aircraft use, a great deal of attention has been paid to the sand. Synthetic sands are used almost universally for magnesium castings for aircraft purposes. These sands are tailor-made to suit the specific characteristics of magnesium metal.

Grain Fineness. One of the most striking differences between the sands used for magnesium and those most commonly used for other metals is the fineness of the sand. Sands for magnesium are relatively coarse. The basic material is washed silica having an AFS fineness number of about 60. A somewhat rougher surface finish is produced by this sand than would be achieved if a finer base sand were used. Naturally, there are reasons for this sacrifice in surface smoothness, which does, after all, have a certain sales appeal. Coarse sands are selected for magnesium in order to achieve maximum permeability.

High Permeability Sand Desirable

Sands possessing high permeability are desirable in casting magnesium alloys for two reasons:

1. The low specific gravity of magnesium allows gases generated in the mold material to be forced into the liquid metal, unless such gases can escape freely by travelling through the mold material into the venting system of the mold.

2. The passage of mold gases through the walls of a magnesium casting while they are still liquid results in casting defects.

Some metals are relatively unreactive with mold gases, which can therefore pass through the liquid metal wall and leave no trace of their passage. Not so, magnesium alloys, which react with mold gases to form non-metallic films. The passage of mold gases through the wall of a magnesium casting will usually result in leaving films of reaction product entrapped in the casting, forming discontinuities in the metallic structure which may impair both the load-carrying capacity and the pressure-tightness of the part.

It is not stated that fine sands cannot be used in casting magnesium or that they have never been used. Their use results in more difficulty with blow-type defects, and except where excellent surface finish has been at a premium, foundrymen have generally compromised on a grain fineness around 60.

Binders. The clay-water system has been the basic binder system used universally for magnesium molding sands—as indeed it has been

for most other metals since the beginnings of the foundry industry. In the synthetic molding sands that are used with magnesium, bentonite is added to the raw washed silica. When the sand is then tempered with water, a bond develops, providing a proper degree of green strength and hot strength. Either western bentonite or southern bentonite can be used, or a combination of the two.

Western bentonite and southern bentonite can be combined in different proportions to vary the flowability, green strength, and hot strength properties of the sand. Usually, about 4 per cent total clay is used in the new sand. Each time the sand is re-tempered after use, a further addition is made, but of course this addition is partially to compensate for quantities of core sand that get mixed with the molding sand at shakeout and require clay for bonding.

The equipment and technique used in conditioning molding sand are as important as the quantities and types of binder used. Thorough mixing of the sand with its binder is required, and beyond mere mixing, a mulling action, in which the mixing takes place under a compressive force, is desirable. Both dry-mulling (i.e., before liquid additives are added) and wet mulling are a part of the procedure necessary to keep the molding sand in top condition.

Screening of the sand to remove foreign materials is practiced. A certain amount of good sand in the form of lumps is rejected at this stage of the reconditioning, because it is considered desirable to replace the sand heap gradually by rejection of some old sand and replacement by new, so that build-up of fines and foreign materials in the sand will not become objectionably high. Aeration of the sand is another important stage of its reconditioning between each use; in this step the sand is mechanically "fluffed up" after having undergone the compressive action of the mulling operation.

Other materials besides clay are sometimes added to the molding sand. Wood flour is sometimes added to the sand if scabbing or buckles become a problem. Cereal additions can also be made to influence the green strength. "Negative binders" such as kerosene or light petroleum oil can be added to improve flowability, usually at a sacrifice in strength of the sand.

In addition to the amounts and types of binders used and the mechanics of their addition to the sand, another factor importantly affecting the properties of the sand is its temperature. It is desirable to keep the sand as cold as practical, and limit the range of temperatures at which it is used, to avoid excessive variations in the properties of the sand supplied to the molder.

One of the major advances in magnesium casting technology in recent years has been the development of superior binders for core sands. The development of good binders for core sands has been a difficult problem for magnesium because so many properties are needed in combination in the same sand. These include:

- 1. High green strength is desirable, so that dimensionally accurate cores can be made. Low green strength may result in sagging or distortion of the core before it is baked.
- 2. High flowability is desired so that smoother, firmer-rammed cores are readily made and mechanical aids such as core blowing machines can be employed.
- 3. High baked strengths are desired so that complex fragile cores can be handled readily without excessive breakage.
- 4. High collapsibility, under the influence of the heat imparted to the sand by the solidifying casting, is needed.
- 5. A baking temperature low enough so that inhibitors incorporated in the sand mix will not be lost in the baking process is desirable.
- 6. Reclaimability of the sand is desirable.

Obviously, it is not possible to enjoy a maximum in all of these various properties at the same time. High green strength and flowability are to a degree mutually exclusive. Similarly, high baked strength and high collapsibility are hard to achieve simultaneously. Compromises are necessary.

The development of urea-formaldehyde binders has been an outstanding advance toward solving this problem. The best core sand mixes for magnesium are based on this binder for dry strength, plus cereal binders for the desired green strength. Mixtures are in use that have sufficient green strength to produce dimensionally accurate cores for most shapes, yet have sufficient flowability to be readily used in core blowing machines. These cores develop adequate baked strength for convenient handling, yet have outstanding collapsibility. Their good collapsibility is important because magnesium alloys have a low heat content, and therefore the cores are not subjected to severe thermal conditions in the solidification of the casting.

If the cores were to retain too much strength, they would subject the solidifying casting to excessive restraint, leading to hot-cracking of the casting, or to mechanical breakage of castings in the knock-out operation. The use of urea-formaldehyde binders also permits a low baking temperature, retaining inhibitors in the core which would be burned off at higher baking temperatures.

Oil binders are suitable for cores for magnesium practice in a number of respects, but have poorer collapsibility than the urea-formaldehyde type. This results in greater difficulty in knocking out the cores in intricately cored parts, as well as greater hot-cracking tendency. Most oil binders also require a higher baking temperature to fully develop their baked strength.

Cereal binders are used to some extent because cereal bonded core sand can be reclaimed and re-used at considerable economy. Unlike urea-formaldehyde or the oil binders, cereal retains its bonding capacity through repeated baking cycles, and cereal sands can therefore be re-used by simply crushing and adding minor quantities of binder and inhibitors to replace those burned out of the sand surfaces in contact with the casting. The cereal sands, however, have poorer flowability than the oil or urea-formaldehyde mixtures, and lend themselves less readily to blowing. They also have poor collapsibility compared with the urea-formaldehyde bonded sands.

H. E. Elliott
Asst. Fdry. Supt.
Dow Chemical Co., Bay City, Mich.

Skin drying a cheek mold. Cast magnesium flasks are rigid and accurate without excessive weight.

Blowing cores for aircraft wheel.

Mold for a large casting is partially cored with first cheek in place.

Checking cores with cast magnesium gauge before placing cheek.

Negative binders are also used to some extent in core sands. Light oils and special, proprietary mold-release agents are sometimes added to the sands to increase flowability or reduce stickiness, but usually a loss of green strength accompanies the use of such modifiers of the mechanical properties of the sand.

Inhibitors. Probably the most fundamental difference between sands for magnesium and sands for other commercial casting metals is the use of inhibitors. Inhibitors are added to magnesium sands to control chemical reaction between the metal and the mold atmosphere, and between the metal and the mold material. Liquid magnesium has a strong affinity for oxygen and will decompose water, silica, or clay—the three basic components of a mold—to get it. Inhibitors are added to the sand to control such reactions.

Inhibitors control these oxidation reactions by reacting themselves with the metal to form protective films. Very effective inhibitors are in use, and the problem of "burning" is very much under control. It is probable that if there are limitations on the size of castings that it is practical to pour of magnesium alloys, these limitations are based purely on the mechanical aspects of constructing large enough molds and handling large enough volumes of metal. No metallurgical problems are known that place an upper limit on the size of casting that can be made, and the problem of reaction between the metal and the molding sand has not produced such a limit.

The inhibitors most commonly used for molding sands are sulphur, boric acid, certain glycols, and certain volatile and non-volatile fluorides. The same inhibitors are used for core sands with the exception of the glycols, which would be largely decomposed at the necessary baking temperatures. For that matter, much of the sulphur that is used as a core sand inhibitor is lost in baking, but since the moisture is driven off in the baking of a core, less total inhibitor content suffices with cores than is required in green molds.

The sulphur in the sand mixture is probably the most effective inhibitor during the mold filling stage, and its primary action is probably to prevent reaction between the metal and the mold atmosphere. To supplement this action, the mold is generally purged by flushing it with sulphur dioxide gas. The other inhibitors probably reach their maximum effectiveness later in the casting process and must retain their effectiveness until the casting is cold enough so that reaction between the metal and mold will no longer be able to start.

Tempering Agents. In addition to the base sand, the binders, and the inhibitors, the remaining ingredient of foundry sands is the tempering agents. Usually, the sand is tempered, or adjusted to the proper molding consistency, with water. In the case of molding sand, the amount of water added will have to be varied with the temperature of the sand. The characteristics of the binders are to a considerable extent temperature-dependent, and a hot sand will usually require a greater water content to have sufficient deformation to be ideally moldable. Then, too, a hot sand will lose moisture by evaporation at a greater rate, and this factor will indicate the use of a larger amount of tempering water.

Another tempering agent much used in sands for magnesium is glycol, used in place of a part of the tempering water. This practice results in less tendency of the sand to dry out in the period between tempering and use, and therefore results in a more uniformly moldable sand being delivered to the molder. The glycol also has considerable value, in combination with boric acid, as an inhibitor.

Corebaking. The same corebaking methods and equipment that are used for cores for other metals are used for cores for magnesium foundry practice. Gas or oil-fired ovens, either batch-type or continuous-type, are most common. The urea-formaldehyde binders that are so valuable for magnesium cores for other reasons lend themselves well to dielectric coremaking, which is gaining considerable usage in magnesium foundries.

Molding and Coremaking

Molding and coremaking practices for magnesium differ relatively little from corresponding practices for other metals. Perhaps the greatest differences have to do with dimensional control. Most applications of magnesium castings have attempted to take advantage of the light weight of the material. This has resulted in relatively thin-walled designs and a demand for close dimensional tolerances.

Dimensional accuracy is attained by using accurate equipment carefully. One practice that has promoted dimensional accuracy of magnesium castings has been the use of good flask equipment. To give a mold of best accuracy, the flask used should be accurate and rigid and should retain its trueness through the repeated and heavy abuse of shaking out the casting. Many magnesium foundries have found cast magnesium flasks to be an excellent solution to this problem. By use of cast magnesium, a rigid, accurate flask is obtained without an excessive weight penalty.

Extensive gauging has also been a part of the procedure for achieving accuracy. Core sizing and setting fixtures and checking gauges are much in evidence in any quality magnesium foundry. Here again cast magnesium is found to be an excellent material for such a thing as a gauge, which must retain accurate dimensions, but must also be handled frequently and therefore needs to be of light weight.

As to methods of mold and coremaking, there is little difference between the practices for magnesium and those for other metals. All kinds of molding machines have been used for molding for magnesium — jolt machines, squeeze machines, slingers, core blowers—and with all combinations of strip and roll-over features. Fundamentally, a magnesium foundry is as adaptable to mechanization as any other metal, given comparable quantities to produce and comparable simplicity of design.

Transferring magnesium alloy from 1500-2000-lb pre-melting units, where composition has been obtained, to crucibles for refining and pouring.

A key operation in any foundry is the preparation of the metal and the delivery of it to the mold. Careful melting room control is particularly important in a magnesium alloy foundry. One of the most basic cost disadvantages that magnesium casting alloys have in relation to other metals lies in the melt losses that are sustained. Molten magnesium oxidizes readily in contact with the atmosphere and must be protected to prevent loss by conversion to the oxide.

Fluxes Cover Exposed Surface

Commercially this is done today with fluxes which cover exposed metal surfaces and protect them from contact with the atmosphere. Such protection is never complete, and some burning is almost inevitable, especially during melt down. The resulting oxides are removed from the melt by combination with the melting and refining fluxes. Additional quantities of metals are lost by mechanical entrapment in the resulting sludges.

In a quality magnesium foundry, the average poured metal ratio frequently runs about 4:1. In addition, it is necessary to leave a generous heel of metal in the pouring crucible to avoid flux contamination. When scrap losses are considered, often as much as six pounds of metal must be melted for every pound of metal that is shipped in the form of good castings. The removal of the generous risers and gates that are common in magnesium casting practice generates a considerable quantity of fines that vary in recoverability inversely with their fineness. All of these factors result in a metal loss approximating 20-25 per cent in a quality magnesium foundry. Thus, for every 100 pounds of castings sold, about 120 to 125 pounds of raw metal must be bought and introduced into the metal system. The economic importance of good melting room control is readily apparent.

To achieve highest casting quality, however, no short-cuts can be tolerated, as casting quality is very sensitive to the quality of the metal poured into the mold. There are four principal quality requisites of a properly prepared magnesium melt: (a) low dissolved gas content, (b) freedom from oxides, (c) freedom from entrained flux, and (d) tendency toward fine grain on solidification. The following discussion of melting practice will indicate how each of these requisites is achieved.

In general, there are two families of magnesium casting alloys of commercial importance—the Mg-Al-Zn family, and the zirconium containing family. These two families of alloys are handled differently and therefore must be discussed entirely separately.

Mg-Al-Zn Alloys. These alloys are generally pre-melted in large mass-melting furnaces of about 1500 to 2000-lb. capacity. The metal is brought to composition in these pre-melting units and then transferred to smaller crucibles for refining and pouring.

Melting in the mass pre-melters is done under the protection of a fluid flux that retains its fluidity and covering power throughout the melting cycle. This flux is designed for maximum protection during melt-down and holding, but does not thicken up, and therefore tends to be carried over with the metal when metal is poured from the container.

In the refining crucible the flux used is quite fluid when first thrown on the metal and allowed to melt. Thus it promptly forms a good protective covering of the exposed melt surface, then thickens, forming a crust, as it remains exposed to the atmosphere at high temperatures. When the time comes to pour the metal, the flux covering consists of a crust of solids which can be skimmed back and prevented from becoming a part of the metal stream. During the pouring operation itself, the metal is protected by dusting with agents that form only a thin protective film on the exposed metal surfaces, until the metal reaches the protective atmosphere generated in the mold by the inhibitors present in the mold material.

When the metal is transferred from the mass pre-melters to the refining crucibles, the first operation is the cleansing of the metal of any oxides that may have formed in the melt-down and transfer operations. This may be accomplished by stirring in a quantity of flux—usually about 1 per cent of the weight of the melt. This refining flux combines with oxides forming a heavy sludge that separates from the melt.

This cleansing step can be omitted if the metal is degassed by bubbling a vigorous stream of chlorine gas through the melt in the temperature range of 1320-1400 F. This removes dissolved hydrogen gas from the melt, thereby greatly reducing the tendency toward microporosity in the resulting casting. Chlorination also causes formation of a quantity of magnesium chloride, and the stirring of this flux through the melt. This results in a very thorough cleansing of oxides from the metal, more effective than any other practical method of flux refining.

It is important to conduct the chlorination in the proper temperature range. Below about 1320 F, the $MgCl_2$ formed will be in the solid state, and will not protect the melt from oxiding rapidly under the agitation produced by the chlorination. Above 1400 F, excessive quantities of $MgCl_2$ are formed.

After the chlorination or flux refining operation, the melt is grain-refined. This may be done by either superheating or carbon inoculation. The superheating method consists of heating the melt to a temperature approximating 1650 F, and holding at that approximate temperature for an interval. When the metal is subsequently cooled rapidly to the pouring temperature and poured, the resulting casting possesses a refined grain-structure, which enhances its properties and improves its response to heat treatment.

An alternate method of grain refinement consists of inoculating the melt with a carbon-containing material at about 1450 F. Several carbon-containing materials have been used, including lamp black, calcium carbide, carbon tetrachloride, and various halogenated hydrocarbons. Carbon treatment is not consistently effective if carried out at temperatures much below 1400 F. There is a danger of over-treatment and grain-coarsening if a thermal superheat is superimposed on a carbon inoculation.

Following grain refining, the melt is removed from the furnace and taken to a pouring station. Here the flux covering is removed, the melt is cooled to the proper pouring temperature, and the metal is poured under the protection of dusting agents as described above.

The melting fluxes used contain $MgCl_2$ and are hygroscopic. It is vital to keep them out of the casting, as entrapped fluxes produce blooms by absorption of moisture, and create an electrolytic cell which consumes the magnesium in the vicinity of the inclusion. They also lead to moisture pick-up on melting tools such

Degassing the alloy in the crucible by chlorination reduces microporosity and is the most effective practical method of flux refining.

as skimmers and ladles, making it highly necessary to preheat such tools carefully before they are dipped into the melt. Diligence in following prescribed procedures is the price that must be paid to avoid these hazards.

Zr-Containing Alloys. There are many similarities and some important differences in the preparation of the Zr-containing alloys. These alloys may be premelted in mass melting equipment, similar to the Mg-Al-Zn alloys, using either scrap metal or new metal charge. However, they are generally brought to final composition in the refining crucibles from which the metal is poured into the castings.

No degassing or grain-refining treatments are reuired with the zirconium-containing alloys, since zirconium is a powerful grain-refiner and also combines with hydrogen to form insoluble compounds. However, a flux refining operation is very important with these alloys since they oxidize more freely than the Mg-Al-Zn alloys and are therefore more difficult to protect from burning.

Most of the commercial Zr-bearing alloys also contain rare earth metals as a major alloying ingredient. The fluxes used to melt and refine rare earth-containing alloys should be free of $MgCl_2$, since it combines with the rare earth metals to form rare-earth metal chlorides, resulting in loss of rare earths from the melt. Fluxes that do not contain $MgCl_2$ do not thicken up as rapidly on exposure to heat as do those used for Mg-Al-Zn melting practice. Therefore, avoiding flux inclusions in rare-earth metal castings reuires greater care and attention than is required in the Mg-Al-Zn alloys.

Gates and Risers Elaborate

Gating and risering for magnesium casting is more elaborate than for most other commercial casting alloys. As mentioned earlier, a poured metal ratio of about 4:1 is typical for quality magnesium work. The following discussion will clarify some of the reasons for the relatively complex gating and risering systems used for magnesium.

Gating. It is important in casting any metal to deliver clean metal to the mold cavity and avoid entrapping dross in the casting. The chemical activity of magnesium imparts to it a high drossing tendency. Turbulent flow in the gating system will result in formation of a dross consisting of skins of oxide mixed with bubbles of mold gases. Considerable care is required to avoid generating excessive dross in the gating and prevent it from entering the casting.

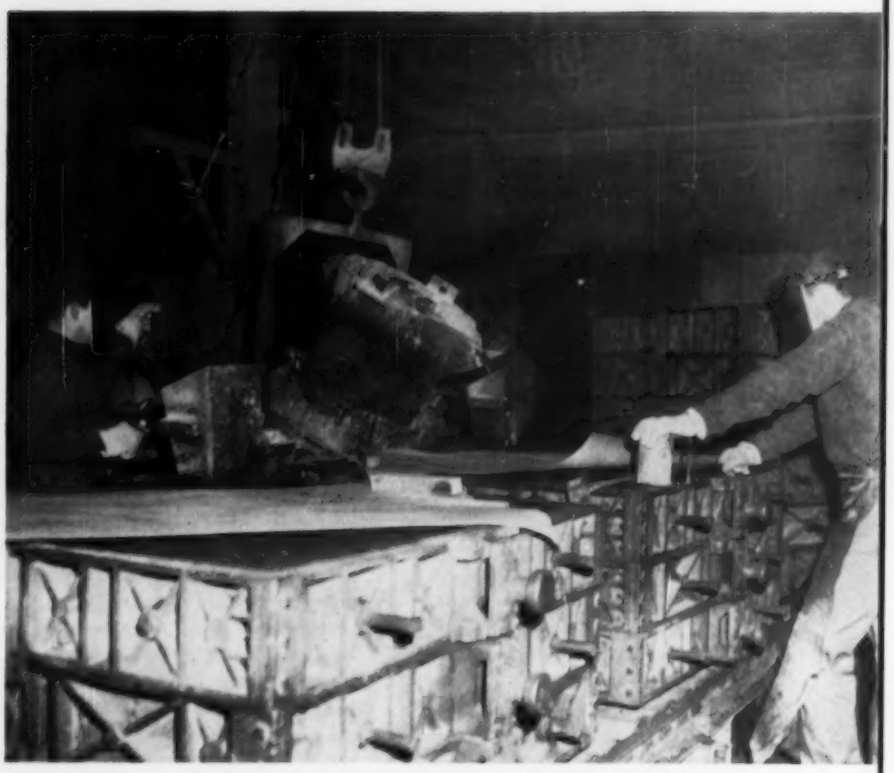
One feature of the gating of magnesium castings is that top pouring is ruled out. Dross is formed and trapped in the casting if the metal tumbles in from above. Bottom filling of the casting cavity is necessary. The metal usually is brought to the lowest level of the casting by means of a down sprue. The metal is then filtered by passing it through a screening arrangement before it is introduced into the bottom of the casting cavity. This filtering action removes any dross that formed in the sprue and pouring cup, and ensures that clean metal will flow into the casting cavity.

Another feature of magnesium gating systems is the use of numerous, well-distributed ingates. Excessive flow through a single ingate is avoided, and an attempt is made to avoid travelling the metal that enters an ingate too far before it reaches its final resting place in the casting. The low heat content of magnesium causes it to lose its heat and set-up rapidly, making it inadvisable to try to travel the metal too far, then expect it to fill out intricate passages completely. A common practice is to employ a ring runner entirely around the base of a casting, with numerous gates and sometimes a continuous gate around the periphery of the part.

While bottom filling of the casting is necessary to avoid dross inclusions, it is desirable to fill risers directly from the gating system without flowing the riser metal through the casting cavity. If hot metal is introduced directly into the riser, it can feed the casting more effectively during solidification. Therefore, it is common to make provision for hot-shotting risers, and these provisions often add to the complexity of the gating system.

Another feature characteristic of magnesium gating practice is the use of large, numerous risers. Solidification of a magnesium casting is rapid, due to the low heat content of the metal. One does not have a long solidification period to work with, in which to set up desired thermal gradients from the risers to the cooler portions of the casting. If the risers are to perform their function as heat reservoirs and set up the desired thermal conditions, they must do so fast. Therefore, they are larger and more closely spaced in magnesium practice than with many other commercial casting alloys.

Still another characteristic feature of magnesium gating practice is the generous use of chills to aid in establishing desired solidification patterns. Chills are a very valuable tool to the founder of magnesium castings, particularly in intricate castings possessing extreme section thickness contrasts in their design.



All castings are bottom gated; magnesium is strained through screens.

After the Shakeout

In a quality magnesium foundry, scrap losses normally range from 15 to 20 per cent of all castings produced. The first objective in the processing of magnesium castings, then, is to give them a critical inspection for flaws as soon as possible, so that if any feature of the casting practice is leading to excessive scrap, the cause can be located and corrected before excessive scrap has been produced.

As soon as the molding sand has been shaken from the castings and the internal cores have been knocked out, the castings are given a sand blasting operation to remove any adhering sand particles. The castings are then taken to the band saws, where many of the gates and risers are removed. Magnesium alloys are very freely machineable, and standard metal-cutting bandsaws are useful in cutting through very heavy magnesium alloy sections.

While the castings are still in the band saw area, they are given a "hot" inspection. This is necessarily not exhaustive, and normally only the more obvious or prominent defects are uncovered here. Yet often such an early inspection pays off when it uncovers an indentation in the casting due to a damaged pattern, or a shinkage defect due to an

inadvertently omitted chill or riser, and has the trouble corrected before too many rejects have been produced.

Not all of the risers are removed by band sawing. A goodly number are more readily removed by machine cleaning operations. Turret lathes, vertical boring mills, and hub mills are useful in removing risers and riser pads, especially from symmetrically-shaped castings.

As soon as all the risers that would obstruct thorough examination have been removed, the castings are prepared for their first critical inspection, the "rough" inspection. The preparation consists of dipping the casting in a dilute sulphuric acid solution to etch off about 0.002 in. of surface metal; this is followed by a rinse in cold water, and then by a "chrome pickle" dip. After the chrome pickle, the casting is again rinsed in cold water followed by a hot water rinse. When the castings have dried following this hot water rinse, they are ready for rough inspection.

The acid etch serves to open up any fine cracks or seams, while the chrome pickle serves to produce coloration effects that improve the visibility of fine defects that may be present.

Rough inspection is carried out under ample lighting conditions, and the castings are carefully examined for the presence of any condition, dimensional or metallurgical, that would impair the serviceability of the part. For dimensional checking, dial calipers and simple gauges are provided, but more elaborate dimensional checking devices are employed at a later stage of processing.

Following the rough inspection, a great many other quality checks remain to be made, and there are a number of other important steps in the physical processing of the part. The exact sequence of these operations is not critical.

A great deal of casting-cleaning work is done on magnesium aircraft castings to improve their surface finish. Fins, mismatches, irregularities due to chill marks, and excessive surface roughness are removed by various means. These means include rotary filing, grinding, chipping, and buffing.

It is extremely important that attention be given to the disposition of the fines generated in these operations. The "coarser fines" such as those generated by chipping and filing, along with chips generated in machine cleaning operations, present no particular hazard. Fires originating in the generating of these materials are practically unknown in normal operations. The very fine dusts produced by grinding and buffing operations require much more care and attention. They are highly inflammable and can be ignited by a spark, producing a flash ignition that can be injurious to the operator as well as lead to more extensive fires.

Well designed and carefully maintained dust collectors must be used in connection with these operations. These collectors draw off all dust from the work and immerse it in large excesses of water. The design of the collecting system must avoid ledges and irregularities where accumulations of dust can be caught and collected, for a chance spark drawn into the collector could ignite such accumulations at serious hazard. Sludges generated by these operations are disposed of at frequent intervals by burning them, under close supervision, at dump areas.

Another phase of the processing of magnesium alloy castings is heat treatment. Magnesium castings are supplied in various conditions including fully solution heat treated, heat treated and aged, as-cast, and as-cast and aged. Heat treatment is generally done in electric ovens of the recirculating-air-type, under very close temperature control. Temperature control is critical. If the castings are overheated, fusion of the eutectic phase will occur, resulting in damage to the casting in the form of fusion voids. However, to achieve most complete solution of the eutectic phase, the temperature must be held very close to this upper limit above which damage can occur. Very careful checks are made to keep the solution treating furnaces operating in such a way that all parts of the furnace will be maintained within ± 7 F of the nominal temperature.

Special furnace atmospheres are also a requisite. Sulphur dioxide is introduced into the furnace at such a rate as to maintain a concentration of about 0.7 per cent. Purpose of the SO_2 is to prevent ignition of the castings in the furnace by maintaining a protective atmosphere.

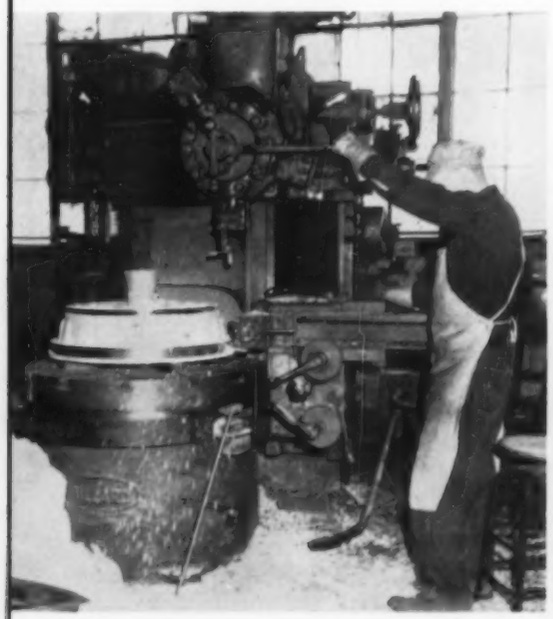
Aging of castings is conducted at much lower temperatures, depending on the alloy, from 300 F to 600 F. Sulphur dioxide atmospheres are not necessary at these temperatures, and temperature control is not so critical at the aging temperatures.

Another phase of processing is impregnation. To insure pressure tightness of some parts, castings which weep or sweat on pressure testing, but do not contain blow holes or other similar defects, are subjected to an impregnation. There are a number of recognized impregnants and several recognized methods of applying them.

Straightening of castings is recognized as a normal processing operation. Usually straightening is done hot, by applying pressure while holding the casting in a fixture. The proper stress-relieving treatment for the alloy involved is applied following the straightening operation.

Salvage operations that are employed on magnesium castings include weld-repairing and peening. Neither is permitted in highly stressed areas of the casting; permissible areas are designated by the customers. Only certain types of defects may be weld-repaired, namely, those the full extent of which can be clearly determined, such as a dirt hole or blow hole. In all cases, the defective material is completely tooled out of the affected area. Weld metal is deposited by the inert-gas shielded arc-welding process using a

Removing the riser from a wheel casting with a boring mill.



Magnesium may be as-cast, as-cast and aged, heat treated, or heat treated and aged. Electric, recirculating-type oven has close control.

tungsten electrode and helium or argon gas as the inert atmosphere.

The final processing operation, other than further inspection steps to be discussed, consists in preparing the casting for shipment. This consists of a final touch-up of rough areas missed in previous cleaning operations followed by a sand blast or shot blast to reduce highlights produced by rotary filing and grinding operations. This is followed by a final acid pickle and chrome pickle treatment, for protection of the part from atmospheric corrosion until it has received the proper permanent protective treatments after machining by the customer.

Numerous special inspection steps are taken to insure the high quality and close dimensional control of magnesium castings. The following are the more important:

■ Radiography is valuable as a nondestructive test to check the internal soundness of magnesium castings. Use of it varies from examining 100 per cent of the area of all castings on a job to use on a spot check basis as a control measure.

■ Another sensitive nondestructive quality check is the use of fluorescent penetrants, in conjunction with ultra-violet light, to determine the presence of fine cracks, seams, or porosity extending to the surface.

■ A useful destructive quality check is fracture examination. Microporosity normally is discovered by radiography, a nondestructive test, but radiography is sometimes not sensitive enough to reveal this defect when it occurs in extremely heavy sections or in junctions of a number of walls. Fracture of a heat-treated casting discloses microporosity as an area of discoloration on the fracture.

■ A much used check for dimensional accuracy is fixture examination. The casting is placed in a special fixture equipped with slides and stops which are used to determine whether bosses, flanges, walls, etc., are in proper relation so that the casting will machine up properly. Usually, the fixture is also equipped with cutters that machine starting points into the casting, from which the customer begins his machining operations.

Every casting is given a final visual inspection before shipment.

A well equipped and active control laboratory is a feature of any quality magnesium foundry. A systematic and consistent program for checking the proper functioning of many kinds of equipment and operations is essential to maintaining high quality of the product. Among the checks that a well-planned control laboratory makes may be the following:

■ 1. Chemical control of alloy composition.

■ 2. Determination of mechanical properties of test bars representing each melt and each heat treat batch.

■ 3. Control of the chemical composition and mechanical properties of the sand.

■ 4. Checking and reporting of the temperature control of heat treating and core baking equipment.

■ 5. Checking and reporting of the accuracy of temperature measuring instruments in the melting rooms and at the pouring stations.

■ 6. Checking and reporting of metallurgical quality of the metal, by means of checks on grain size, gas content, flux contamination, and degree of solution heat treatment of castings.

■ 7. Checking on the dimensional characteristics of castings, patterns, and gauges by means of lay-out checks.

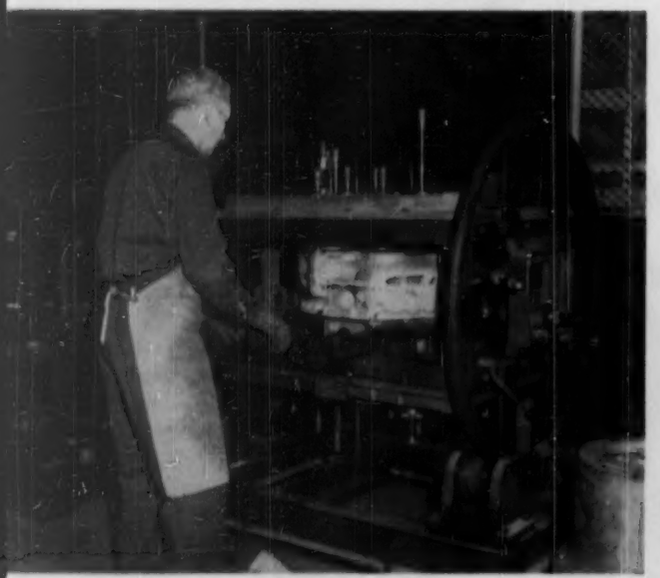
■ 8. Receiving inspection of materials used in the process.

■ 9. Inspection of processing materials such as pickle solutions, impregnating fluids, furnace atmospheres, and the like.

■ 10. Caliper checking of melting crucibles and pots to determine whether they may remain safely in service.

Regular and systematic checking of all of these phases of the operation are vital in maintaining low scrap losses and high quality of the product.

Fixture examining for dimensional accuracy.



Analyzing rapidly with direct-reading spectrometer.

Metal Treaters Meet

The 37th consecutive meeting of the Metal Treating Institute was held in Los Angeles, Calif., on May 9-11. Titanium was the subject presented by Harry Brenner, Olympic Screw Products Co., during the technical sessions on the first day of the meeting. Another first-day speaker was Graham Hall, Armco Corp., whose subject was *"Precipitation Hardening of Stainless Steel."*

Tuesday morning, May 10, was devoted to a tour of Douglas Aircraft Co.'s El Segundo plant. Speakers and subjects of Wednesday's session were: *"Nickel Alloys as Used in Heat Treating Furnaces & Equipment,"* Allen Niethammer, Pacific Metals Co., Ltd.; *"The Sanford Process,"* John Franklin, Sanford Co.; and *"Heat Treating of Aluminum,"* Mel Hall, Reynolds Metals Co. The afternoons of the three days were devoted to local tours to points of interest.

Three-day Sand School

Sand School for supervisory and technical personnel will be held in Detroit, August 15, 16, and 17, at the Detroit Engineering Society under the sponsorship of the Harry W. Dietert Co., Detroit. There will be no charge for attendance.

Sand school sessions will be patterned on the theme that foundry cost is greatly affected by foundry sands. Sand affects cost in two major ways: 1. The ease with which a core maker or a molder can work a sand can be materially altered by compounding an easy-to-work sand. 2. Casting quality can be improved and scrap loss can be reduced by proper selection and control of sand.

Putting these two items into practice in a foundry will be detailed by studying six distinct sand properties: structural, green, air-set, dry, hot, and retained. A detailed study will be made of each group of properties.

The proper selection of the better numerical values of each essential sand property will be given, and emphasis will be placed on the fact that when the essential properties are carefully controlled at selected values, the sand requires the least attention and is the most foolproof.

The lectures will be given by Victor M. Rowell, Harry W. Dietert Co. Motion pictures and lantern slides will be used to illustrate the lectures.

Does Your INSURANCE Cover It?

A $12,000 ACCIDENT TURNED ONE FOUNDRYMAN'S THOUGHTS TO ADEQUATE COVERAGE

A. C. SINNETT

■ Insurance protection against losses is a management function too frequently minimized by pressure of production requirements and cost reduction. Discussion of this subject with others in the foundry industry indicates that too little is known and understood about the coverage purchased. This is also true about knowledge of insurance protection available. Strange as it might seem, those in the profession of selling insurance have not done a creditable job insofar as foundries are concerned.

It is imperative, that every foundry have an insurance advisor, or consultant, who can fully and honestly develop an insurance program to suit the requirements. The cost of an insurance program is not only that of the premiums but loss preventative measures that can be taken also. These measures, such as a sprinkler system, have a great effect on the insurance rates and will more than be compensated for in the rate savings. There is also the savings to be obtained from purchasing insurance coverage on a five-year annual pay basis when this method is applicable.

Insurance companies and claim adjusters place great importance on the determination of whether a fire is "friendly" or "hostile." This determination is the basis of whether you can collect for damages or not. In general, a fire is not hostile if wholly confined to the place where it was intended to be. The question of degree of fire or temperature apparently is not considered. An overheated piece of equipment such as a furnace or oven is not a hostile fire unless it goes out of its own confine and damages something other than itself.

For example, if a melting furnace with a weakness in the refractory lining suddenly permits the molten metal to run out on the floor, there would be justifiable claim for whatever damage was done, plus use and occupancy loss if such occurred. The fire was not contained where it was intended.

To further illustrate, take the recent experience of a malleable foundry that had an annealing oven go out of control and melt the contents into a conglomerate mass. This oven was fired by gas and apparently was normal and under control throughout the cycle until approximately two hours after a previous fireman had recorded temperatures that were normal—oven, 1750 F and 1670 F; pots, 1620 F and 1575 F.

The later fireman noticed temperatures as indicated by the pyrometer to be high, so he shut off the manual gas valve, opened the dampers, and opened the butterfly air valve to cool the oven. The only abnormal part of this operation was opening the dampers and continuing to blow in air at the rate of 600 to 800 cfm through the burner with no fuel. Here's what happened.

When the oven was opened, examination disclosed that the packing material had reached a temperature high enough to become molten, run out of the pots, and fuse to the fire brick floor. Tests of the packing material are shown on page 46. A report on the sintering point shows that the first fusion occurred at 2200 F, with 2840 F being the B sintering point.

Upon examination of the refractory walls and roof of the oven (rated at 2600 F), no evidence of excessive temperature was observed. The baffle erected about 8 feet in front of the burner is made from regular fire brick and did not show any signs of excessive temperature.

The thermocouple tubes in the pots on both front and back pots were badly burned but the two oven tubes were normal. The tube in the top of the oven which controls the firing of the oven did not show signs of excessive temperatures and its use was continued in subsequent firings.

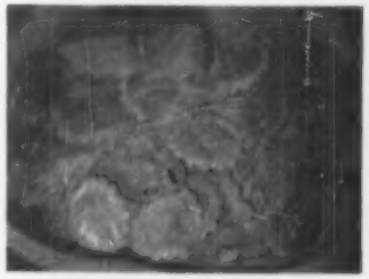
All facts indicate that pots and contents did not burn from excessive firing temperatures from the burner. Excessive temperatures were confined within the pots themselves, burning the castings and fusing the packing material. To have the temperature in the pots as indicated, and to burn the castings and pots, an exothermic reaction had to take place when the fireman opened the dampers and forced air through the burners.

Was this or was it not a fire? Certainly $12,000 worth of castings, pots, and packing material were destroyed. However, under the insurance interpretation of a friendly fire, it was confined to where it belonged and payment for damage was denied by the insuror.

How can such an incident be prevented from occurring again? The human element entered into the loss because someone did something unwisely and without instructions. To overcome such possibilities, there is a fuse for excess temperature protection. This installation blocks off all sources of fuel and air when a predetermined maximum temperature is reached.

If you've had an experience like the exceptional incident just described—there's no record of it happening before—please let *Modern Castings* know about it.—*Editor.*

Incidents that can't be foreseen or prevented can be covered by insurance. Compare your present coverage with the Insurance Check List



Conglomerate mass of castings and packing from 1750 F Furnace.

(furnished by the writer's insurance advisor) contained in this article, and determine further needs.

Note in the first group that depreciation insurance is listed. This is relatively new and should be considered, particularly by those foundries that are heavily depreciated. In this coverage, protection is provided for the difference between the appraisal insurable value and the replacement value. The 80 per cent co-insurance clause usually is included for rate reduction. Analyze your plant and picture the position you would be in if a disastrous fire largely destroyed your buildings and equipment. Would your recovery under present policies put you back in business, or would the recovery on insurable values, as most foundries have, be for approximately 50 per cent of requirements to rebuild?

Check the cost of insurance for dishonesty, disappearance, and destruction, as a blanket covering all employees as compared to specific individuals or positions.

Product insurance is liable to be considered unnecessary. It is true that it may be one that you will never be required to collect from. However, the implied liability that can come home in case of casting failure is such that it should be required insurance by management.

The cost of business interruption in a machinery policy can be kept at a minimum if only motors and equipment whose failure would cause a shut-down are included in the policy.

Properties of Annealing Pot Packing Material

Sample No.	Description	Pyrometric Cone No.	Approx. Temp., F
1	Molten, ran out of pot	10-11	2300-2400
2	Fused, outside of pot	2 badly bloated	2075
3	As used in packing	4 slightly bloated	2129
4	Taken from inside of cylindrical casting inside of pot	7-8	2210-2237

Screen Analysis		Chemical Analysis	
8.0 %	On 4 mesh	Silica	88.7%
57.2 %	6	Iron & Aluminum Oxide	9.6%
34.6 %	12	Calcium Oxide	0.9%
0.02%	20	Magnesium Oxide	0.3%
		Loss on Ignition	0.3%

Insurance Check List for Foundrymen

Fire and Extended Superior Form

- Direct Damage All Property
- Business Interruption
- Depreciation
- Off-Premises Power
- Flood
- Molten Metal
- Railroad Cars

Casualty

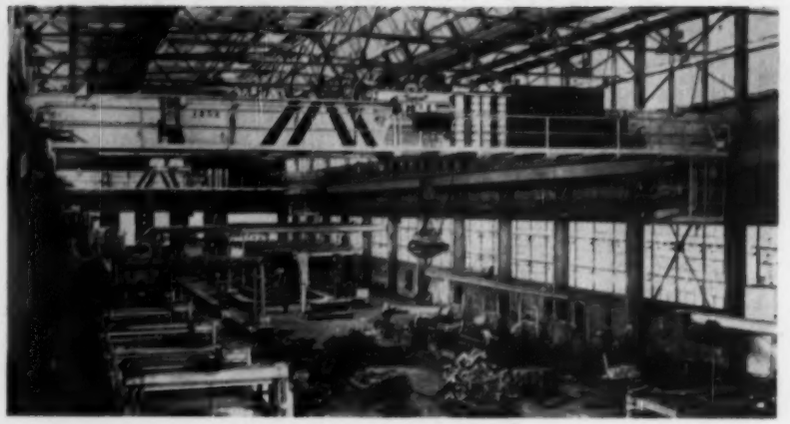
- Workmen's Compensation and Occupational Diseases
- Comprehensive Liability and Damage
  - Direct Auto
  - Non-Owner Auto
  - Elevator
  - Contractural
  - Product

Steam Boiler and Machinery

- Direct and Personal Injury
  - Boiler and Unfired Pressure Vessels
- Machinery and Electrical Objects
  - Direct Damage
- Business Interruption

Marine and Miscellaneous Coverages

- Automobile
  - Compensation
  - Collision
  - Medical
- Railroad and Motor Cargo
- Dishonesty, Disappearance, and Destruction
  - Employee Fidelity
  - Property Damage
  - Forgery and Check Alteration
  - Money and Securities
- Pattern Floater
  - Owned on Premises
  - Owned Off Premises
  - Customers Legal Liability
- Accounts Receivable



Modernization Puts New Life in Old Cranes

ROBERT RICE / *Manager, Engineered Crane Div. Whiting Corp., Harvey, Ill.*

■ Many cranes in use today, even those 30 years old, are still giving good service. However, changes in plant layout and in type of load handled, plus normal wear on crane operating parts, may be seriously hampering full operating efficiency.

In some instances a new crane is the only answer, but in many cases cranes can be modernized economically, appreciably increasing handling efficiency. Modernization makes the crane more efficient and more versatile and reduces crane maintenance costs.

New developments in crane controls, particularly the introduction of magnetic controls, make it possible to achieve greater flexibility in crane operation and greater precision in the spotting of loads. In addition, magnetic controls are much more compact, permitting additional improvements such as the full vision cab which increases both speed and safety of crane handling.

The installation of an auxiliary hoist of lighter capacity and higher speed than the main hoist may make it economical and practical to use the overhead traveling crane for loads which are now being moved through the plant on trucks or dollies.

If the cab-type crane is used so seldom that a full-time operator is not on hand, the crane is probably not used for all of the jobs that it could perform efficiently. Time lost in locating a man who can operate the cab controls and sending him up into the cab can be eliminated and the crane usefulness increased manyfold by fitting the crane with pendant controls.

Reduction of maintenance costs through crane modernization brings up the question of how high maintenance costs should run. A general answer applicable to all classes of service is impossible. One company spent $10,831 on maintenance of one crane in a single year. Costs approaching this figure certainly suggest that a new crane is the logical solution.

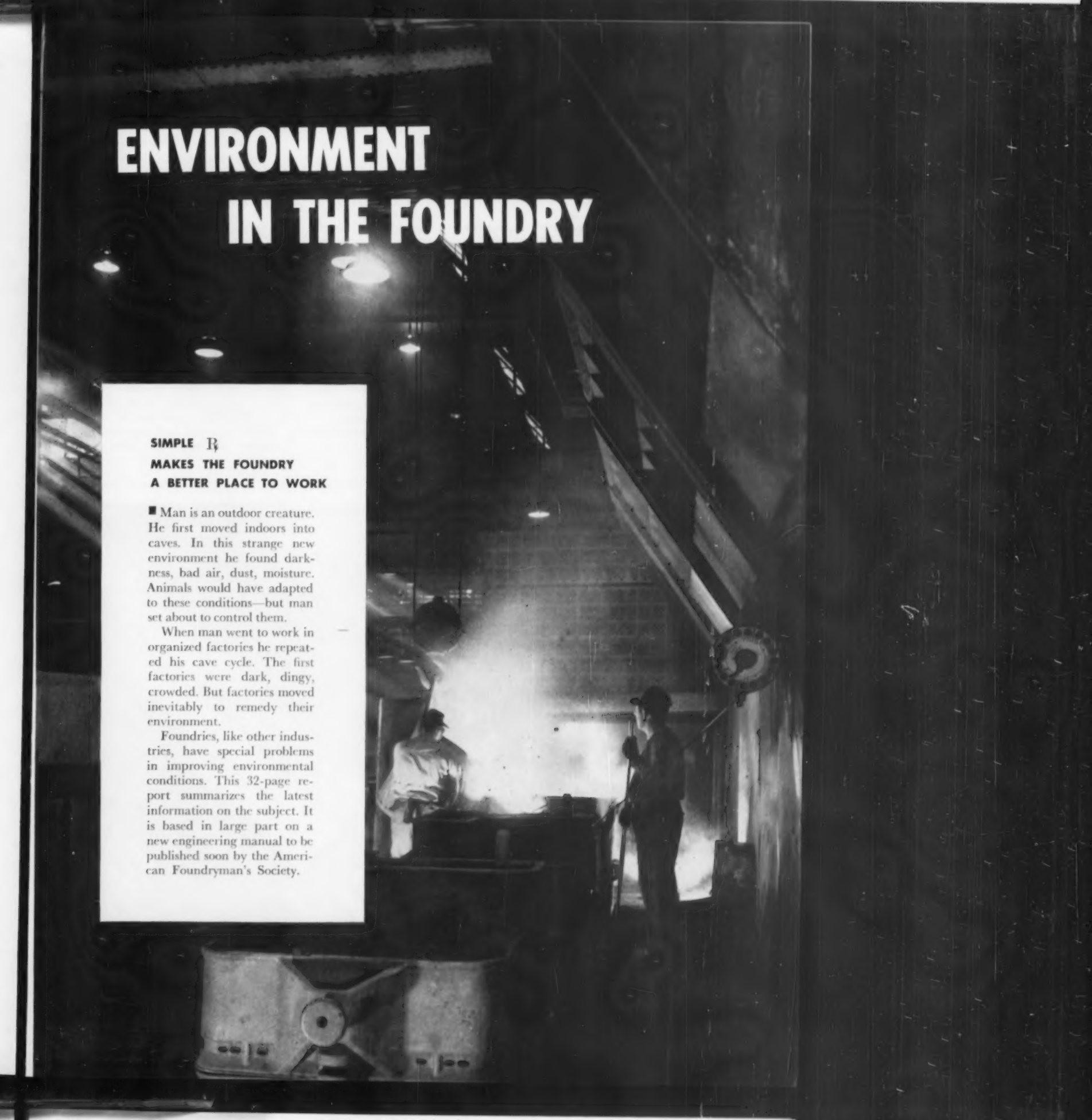
On the other hand, reports on cranes show that many with considerable service are doing a good job with maintenance costs of only a few hundred dollars per year. Obviously, the frequency of crane usage, the extent to which crane capacity is approached (or exceeded), the type of work handled, and the efficiency of the maintenance program all influence crane maintenance costs.

If maintenance costs appear too high on the present crane, consider the following measures:

Cranes in exceptionally hard service sometimes wear out cast iron drums in a year. A worn drum causes cable wear to increase. Costs of maintaining both drums and cables can be reduced by substituting cast steel drums, heat-treated drums, or heat-treated sleeves on existing cast iron drums.

If crane maintenance costs are due to faulty electrical collector systems, consider the installation of a new trolley or the use of trolley collector shoes which have carbon inserts.

ENVIRONMENT IN THE FOUNDRY



SIMPLE R$_{\text{x}}$
MAKES THE FOUNDRY
A BETTER PLACE TO WORK

■ Man is an outdoor creature. He first moved indoors into caves. In this strange new environment he found darkness, bad air, dust, moisture. Animals would have adapted to these conditions—but man set about to control them.

When man went to work in organized factories he repeated his cave cycle. The first factories were dark, dingy, crowded. But factories moved inevitably to remedy their environment.

Foundries, like other industries, have special problems in improving environmental conditions. This 32-page report summarizes the latest information on the subject. It is based in large part on a new engineering manual to be published soon by the American Foundryman's Society.

HYGIENE

Man meets foundry

■ FOR MANY YEARS foundries have not always been considered to be as pleasant places to work as, say, chocolate eclair factories. There have been a good many reasons for this idea. The two most important are (1) it is partly true, and (2) ignorance of the true facts and remedies.

The ignorance has been due in part to the misinformation of workers who, surrounded by strange dusts, vapors and metals, have feared that these existed solely to bring about their speedy demise. Ignorance has resulted in the faulty diagnoses by physicians who have never been inside a foundry. There has been a general lack of information on the subject of industrial health.

But in recent years foundry hygienists and industrial physicians have caught up with the facts concerning the subject.

The foundry does have factors which influence health, safety and comfort. When their causes and effects are understood, however, they can be dealt with as effectively as any other industrial condition.

Foundry processes are the source of:

- Dusts, fumes, gases or vapors.
- Noise.
- Heat.
- Radiation.

These four elements are also part of the non-industrial environment. But from whatever source they come, if man is exposed to them severely enough, his health, safety and comfort are affected. And please note: *intensity and duration of exposure are required in addition to the harmful potential to constitute an undesirable environment.*

What materials and processes in foundry practice do influence

The hazards and dangers of working in foundries are greatly exaggerated and all of them can be controlled.

health, safety and comfort? And what are their characteristics?

- **Acrolein (acrylic aldehyde).** The gas is a result of thermal decomposition of core oil. It is considered a nuisance rather than a toxic material because exposure to one part per million parts of air is intolerable for five minutes. Maximum allowable concentration is 0.5 parts per million. Control consists in local exhaust or air dilution by general ventilation.
- **Aluminum.** Non-toxic. Principal danger is from fires and explosions in dust-collecting systems.
- **Antimony.** Cases of industrial poisoning from antimony are rare and in foundry operations the metal is probably an unimportant contaminant.
- **Beryllium.** Identified as a hazard only in recent years. Beryllium poisoning has two manifestations: acute lung disease similar to pneumonia, and a delayed chemical pneumonitis. Beryllium-copper castings as manufactured today contain about 1.5% beryllium, and no cases have been reported from the use of alloys containing such low percentages of beryllium. However, six cases were reported in one plant engaged in casting a 5% beryllium copper. Compounds of beryllium which come in contact with abraded skin surfaces may cause deep ulcers which are very slow in healing. Symptoms of the disease may occur after months or even years.
- **Chromium.** Air contaminated with chromic acid mist, or with chromates or dichromates, causes chrome ulcers and dermatitis. Exposures occur from melting, gate and head burning, and grinding. Elemental chromium has not been conclusively demonstrated to be toxic but there is some evidence that the oxide can irritate nose and throat. Both the element and the oxide can produce dermatitis. Little difficulty has been experienced in the manufacture of ferrochrome castings. Maximum allowable concentration for chromic oxide is 0.1 milligram per cubic meter of air.
- **Fluorides.** Fluorides are sometimes used in the form of cryolite (sodium aluminum fluoride). Respiratory irritations result from inhalation of fluorides but not when concentration is less than 2.5 milligrams per cubic meter of air—the accepted threshhold limit. Exhaust ventilation is usually indicated at the station where inoculation of the melt occurs.
- **Iron oxide.** Exposure is particularly high when manganese steel castings are involved. Iron oxide is physiologically inert but it produces a non-disabling condition of the lungs called siderosis. In this condition, particles of iron oxide produce shadows in a chest x-ray film similar to those produced by silicosis and it is frequently confused with it in x-ray reports.
- **Lead.** Lead presents the greatest hazard to health in non-ferrous foundries. It enters the body chiefly by inhalation but also by swallowing. Food must not be eaten or liquids drunk from open containers in work areas where lead exposure could occur. Good dust control is essential.
- **Magnesium.** The metal has not been shown to be poisonous as such, but dust and chips cause explosive and fire hazards and special attention should be given to disposal methods.
- **Manganese.** Acute intoxication is almost unknown and chronic poisoning is infrequent. Maximum allowable concentration is 6.0 milligrams per cubic meter of air—a value seldom exceeded even without ventilation.
- **Phosphorus.** Used in the manufacture of phosphor-copper. Acute poisoning from phosphorus has not been demonstrated and chronic poisoning occurs slowly following inhalation of fumes. It is believed that necrosis of the jaw occurs when phosphorus enters the system by way of cavities of the teeth. Persons with poor dental hygiene should not be exposed to the fumes for long periods.
- **Resins.** More resins are now being used with the advent of shell molding. Most resins used are toxic but protection lies in the fact that in severe concentrations man cannot tolerate them. In practice, therefore, fumes from the resins will be at most a nuisance.
- **Sea coal.** Principally carbon used in molding sand for facing, carbon dust causes a lung condition called anthracosis which shows shadows in a chest X-ray but is considered to be relatively harmless.
- **Silica.** This is a principal atmospheric contaminant. Free silica causes silicosis which is characterized in x-rays by nodular shadows due to true fibrosis and scarring of the lung tissue. It is disabling in advanced stages or when accompanied by tuberculosis. To produce silicosis, exposure must be two years or longer; the particle size must be less than 5 microns in diameter; and there must be a heavy concentration of free silica in the dust. Good housekeeping is one of the most important means of controlling the hazard.
- **Silicones.** Silicones are used as mold-release agents during shell molding. There is evidence that some types are a hazard to health. Hydrolizing types are highly corrosive and present hazards, but in dangerous concentrations they give adequate warning. Employees cannot tolerate harmful atmospheres. Silicones of low toxicity should be used.
- **Solvents.** No absolutely safe solvent exists except, possibly, water. All can be used safely if their toxic properties are known and safe handling procedures are followed. All containers of solvents should have warning labels attached, giving the chemical name and stating the handling precautions to be followed. Some states have such labelling codes with the force of law. Most solvents are flammable.
- **Sulphur dioxide.** It is an irritant and a nuisance and may require exhaust ventilation.
- **Tellurium.** It is used to increase the chill-depth hardness and to improve the machinability of alloys. Fumes are toxic, characterized by a garlic odor. Serious industrial poisonings are rare.
- **Tin.** Considered non-toxic.
- **Zinc.** Inhalation of the fumes of zinc oxide gives rise to a malaria-like illness called "brass-founders' ague." It rarely lasts more than a day, causes no permanent disability and is never fatal.

VENTILATION

Cuts cost, makes the foundry a better place to work

■ **Ventilating systems** are normally installed for one or more of the following reasons:

- To remove or dilute air contaminants or excessive heat to a safe concentration.
- To improve employee morale.
- To provide a more desirable place to work.
- To reduce maintenance.
- To improve plant "housekeeping."

Control of air contaminants is the primary purpose of ventilation in foundries. Obviously, compliance with regulatory codes is the minimum requirement for a ventilating system. Whether this minimum should be exceeded is a matter of individual company preference.

Air flows between two points because of pressure differences at the two points. The difference in pressure may result from variations in air density, as in the case of gravity stacks; from fans creating lower pressure (commonly called suction) at their inlets; or from wind effect on ventilators or buildings.

Air in motion creates a definite pressure which is dependent on its density and velocity, and is termed **velocity pressure** (VP). For air having a density of 0.07495 lb per cut ft $VP = \left(\frac{V}{4005}\right)^2$ where V is the air velocity in feet per minute and VP is the velocity pressure in inches of water. Velocity pressure is always exerted in the direction of air flow and is positive in value.

Confined air, whether in motion or not, is responsible for another pressure which is exerted equally in all directions. This is termed **static pressure** (SP), which may be likened to the pressure exerted by a column of water at rest. It is normally measured at right angles to the walls of the enclosure or duct and may be either positive or negative.

Total pressure (TP) is the algebraic sum of the velocity pressure and static pressure: TP = VP + SP. In ventilating systems these pressures are always expressed in inches water gage.

Air-flow characteristics at duct openings depend on whether the air is being blown or exhausted. Unless a diffuser is used, air blown from an opening continues in the same direction for a considerable distance with relatively small divergence. However, air drawn into the same opening tends to flow into the opening equally from all directions. This is one reason for locating exhaust hoods as close as possible to the source of a contaminant. See p. 51.

■ **General exhaust.** General exhaust by means of gravity ventilators or mechanical exhausters is commonly used to remove contaminants and discharge them to the outside atmosphere, and also to keep the temperature build-up within the building to a minimum.

■ **Intermediate exhaust.** Curtain walls may be used where the contamination or temperature build-up is to be restricted to a particular area. A curtain wall may confine the area from the roof line to the bottom chord of the roof trusses. Roof exhaust fans are then used to exhaust the area. This method is effective only in those cases where the contaminant has a tendency to rise quickly to the underside of the roof with little dispersion.

■ **Local exhaust.** Many operations require complete exhaust in order to remove the contaminant directly from the source. This would include such operations as grinding, buffing

General exhaust system discharges contaminants through stacks and helps keep temperature build-up within the building at a minimum.

and polishing, or where fumes or vapors are produced which may be a nuisance or even dangerous to personnel. Complete exhaust may be accomplished by enclosing the whole operation in a booth.

▪ **Makeup air systems.** In any building from which air is being exhausted (by whatever method) the air being removed must be replaced by incoming air. If no makeup air is provided, air will enter by any convenient route, causing unnecessary drafts on workmen. This infiltration decreases the effectiveness of any exhaust system by increasing the pressure range against which the system must operate.

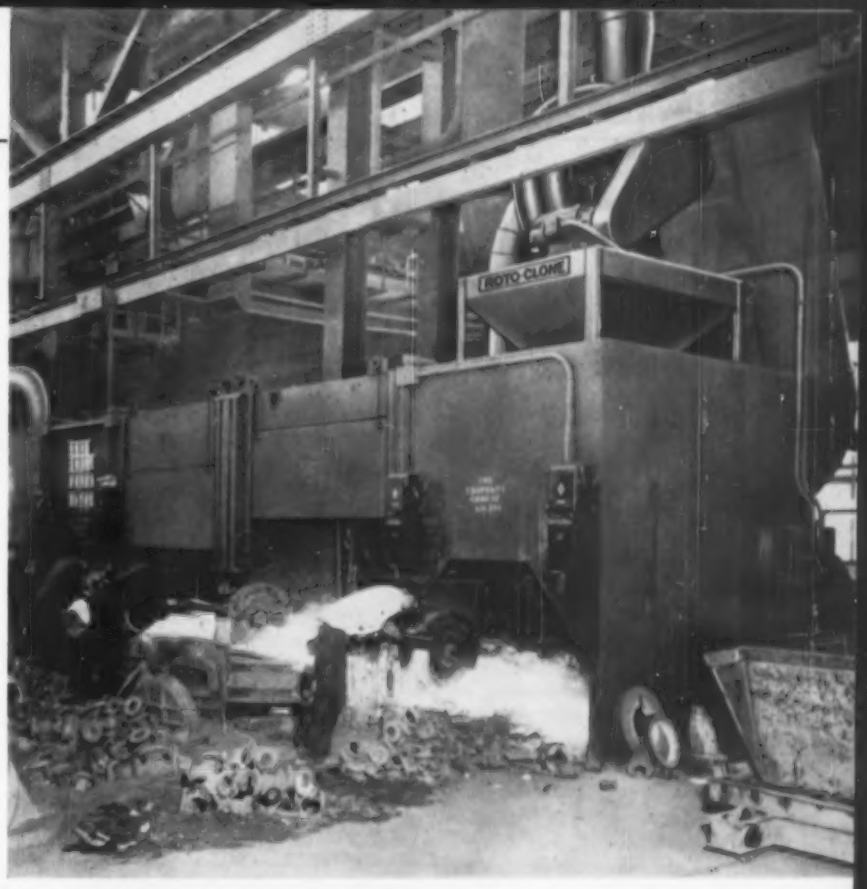
▪ **Recirculation.** In cold climates, the amount of air removed from a plant by general ventilation and local exhaust systems frequently creates a serious heating problem. Where permissible, recirculation of exhaust air can result in important savings in fuel consumption.

Recirculation is forbidden by many states and local regulations, however, regardless of the toxicity of materials involved. Such regulations should be checked before a recirculating system is considered.

▪ **General ventilation.** Sometimes air contaminants (steam or smoke) can be sufficiently removed and controlled through general exhaust ventilation. One advantage of general exhaust is simplicity, since only a gravity ventilator or an exhaust fan in a window or roof ventilator, plus a source of make-up air, is required.

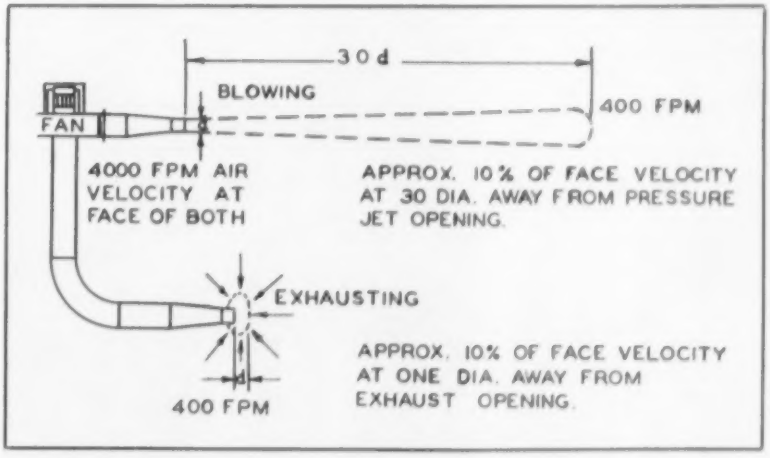
A common problem encountered with roof ventilators is an "air short circuit." If the upper windows in the roof monitor are open the power ventilator will suck in air through them because they offer a path of least resistance to air flow. Air movement on the working floors then becomes negligible.

General ventilation is actually dilution ventilation. It does not prevent contaminants from entering the breathing zone but it reduces the concentration by introducing a supply of relatively clean air. Dilution is seldom uniform, however, and persons working in the immediate area of a contaminating source are little benefited by general ventilation.



Local exhaust system removes contamination directly from source in foundry cleaning room operation.

General ventilation of itself seldom affords a complete solution to the problem of removing the contaminants encountered in foundry practice. However, roof ventilators used in conjunction with curtains dropped to the bottom chord of the roof trusses often can give satisfactory results. Usually, general ventilation should be used as an adjunct to local exhaust systems or for dust and fume producing operations that are carried out only occasionally.


30 d
BLOWING
400 FPM
FAN
4000 FPM AIR VELOCITY AT FACE OF BOTH
APPROX. 10% OF FACE VELOCITY AT 30 DIA. AWAY FROM PRESSURE JET OPENING.
EXHAUSTING
APPROX. 10% OF FACE VELOCITY AT ONE DIA. AWAY FROM EXHAUST OPENING.
400 FPM

Hoods are necessary to gather the exhaust. Otherwise sucked-in air would come from all directions—not just from contaminant source.

HOODS and SYSTEMS

Good design is cheaper to build, more efficient to run

■ **Exhaust hoods.** The most important single component of any exhaust system, which determines the adequacy of the design, is the hood or opening through which contaminated air is drawn.

When free air is drawn into an opening as a result of low pressure induced within the exhaust system by fan or other air-moving equipment, it flows toward the negative pressure point from nearly concentric planes, which take the form of spheres.

It is fortunate that this property of natural flow of gases exists since man's very existence depends upon it. Man is able to rid himself of used air by exhaling and to draw fresh air into his lungs by inhaling because of this fact.

The principle is illustrated in a quantitative manner in the chart on page 55 which shows the velocities developed in front of four square openings of various dimensions. It will be noted that with the same volume of air drawn through each opening, the face velocity varies from 4500 ft per min through the 4-in. opening to 720 ft per min through the 10-in. opening. It is of particular interest to note that contrary to what might be expected, all of the openings create approximately the same velocity at a distance of only 6 in. from the face of the hoods.

Equations for some of the more fundamental hood shapes are offered in this section for those who have problems that do not lend themselves to solution by use of the hood forms ordinarily used.

Equations for Hood Forms

X = Distance in feet from hood face at which velocity V occurs on an axis perpendicular to hood-face centerline. In the case of a sphere, this equals the radius.

V = Average velocity at hood opening.

A = Area of the hood face in sq ft

Q = Total air volume through hood opening = VA

Y = Percent of velocity at hood opening, found at a point X distance from hood.

b and c = Constants for specific ratios of hood sides.

1. Unflanged, Round Openings

$$V = \frac{0.1Q}{X^2 + 0.1A} \quad \text{or} \quad Q = \frac{V\,(X^2 + 0.1A)}{0.1}$$

2. Unflanged, Rectangular Hoods:

$$\frac{Y}{100\text{-}Y} = bA^{1.94}X^{-1.91} = \frac{bA^{1.94}}{X^{1.91}}$$

Values of b for Various Hood Side Ratios

Ratio of Sides	Value of b	Ratio of Sides	Value of b
0.1	0.020	0.6	0.071
0.2	0.037	0.7	0.075
0.3	0.049	0.8	0.078
0.4	0.059	0.9	0.081
0.5	0.065	1.0	0.083

3. Flanged, Circular Openings

$$\frac{Y}{100 - Y} = 0.825\,A^{1.94}X^{1.91}$$

4. Flanged, Rectangular Openings:

$$\frac{Y}{100 - Y} = cA^{0.92}X^{-1.8} = \frac{cA^{0.92}}{X^{1.8}}$$

Values of c for Various Hood Side Ratios

Ratio of Sides	Value of c	Ratio of Sides	Value of c
0.1	0.046	0.6	0.126
0.2	0.072	0.7	0.136
0.3	0.090	0.8	0.138
0.4	0.105	0.9	0.142
0.5	0.117	1.0	0.144

Any dust source may be controlled by designing a hood or exhaust opening on the basis of these equations.

■ **Exhaust system piping design.** Two methods of calculating and designing exhaust systems are widely accepted. The more accurate consists of designing an installation in which system balance is achieved by

Exhaust System Calculation Sheet

Sec. No.	Diam., in.	Length ft	Length Diam's.	Resistance in terms of Velocity Pressure: Straight Pipe	Branch Take-offs and Elbows	Equip. Loss	Orifice Loss	Veloc. Head	Total	Veloc., fpm	Vol., cfm Branch	Vol., cfm Main	Resistance, in. W. G. Branch	Resistance, in. W. G. Main
1	17	12	8.5	0.142	0.19	3.40	——	1.00	4.73	3570	5600	5600	3.75	3.75
2	8	7	10.5	0.21	0.37	2.03	——	——	2.61	4790	1670		3.75	
3	18	8	5.5	0.091	——	——	——	——	0.091	4150		7270		3.85
4	8	7	10.5	0.21	0.37	2.03	——	——	2.61	4850	1870		3.85	
5	20	6	3.5	0.07	0.19	——	——	——	0.26	4220		9140		4.14
5	19	6	4.0	0.066	0.19	——	——	——	0.26	4680		9140		4.20
6	7.5	18	29	0.39	0.19	1.5	——	——	2.28	5230	1600	1600	3.9	3.90
7	7.5	8	13	0.26	0.37	1.5	——	——	2.13	5400	1650		3.9	
8	12	8	8	0.18	0.19	——	——	——	0.37	4150		3250		4.27
9	24	31	15.5	0.24	0.19	——	——	——	0.43	4150		12390		4.74
10	7	17	29	0.60	0.57	6	——	1.00	8.17	5000	1330			12.73
11	30	40	16	0.235	——	——	——	——	0.235	2810		13720		12.85

equalizing the design pressures in the various sections. Thus the pressure of one branch is equal to the pressure of the main or the branch to which it is connected.

In the second method, balance of the various sections of the exhaust system is achieved by providing blast gates in each branch. The use of blast gates allows the designer more freedom in sizing ducts to standard dimensions and permits the use of minimum conveying velocities. This results in a manually balanced system capable of reasonable changes by equipment addition or reduction.

■ **Basis of design.** It is recommended that calculations for pressure losses in hoods, piping, fittings, and elbows be made in terms of velocity pressure. Pressure losses offered in any treatise on the subject of necessity are calculated for new duct work and dust-handling equipment.

■ **The nomograph as an aid in pipe design.** The nomograph on page 54 incorporates several equations involved in exhaust system design and may be used for sample calculations. By means of the scales A to G, a dependent variable can be determined from a given independent quantity. The graph shows the fundamental relationships of:

1. Pipe size (A) to pressure drop (C) by means of pipe diameters (B).
2. Velocity (E) to static pressure (D) and to static pressure expressed in terms of velocity pressure (C).
3. Pipe size (G) to volume of air (F), and the velocity of a given volume of air in given pipe size (E).
4. Velocity to velocity pressure (E).
5. Pipe size to pipe area (G).

■ **Example of system design by the nomograph method.** Following is a step-by-step explanation of the values shown on the calculation sheet (page 52) which apply to the system shown on page 56. The system was calculated as a balanced one, i.e., the branches from any point have the same pressure drop.

■ **Step 1:** Find the hood or device farthest distant from the dust collector or fan. In this case, it is obviously the rotary table blast.

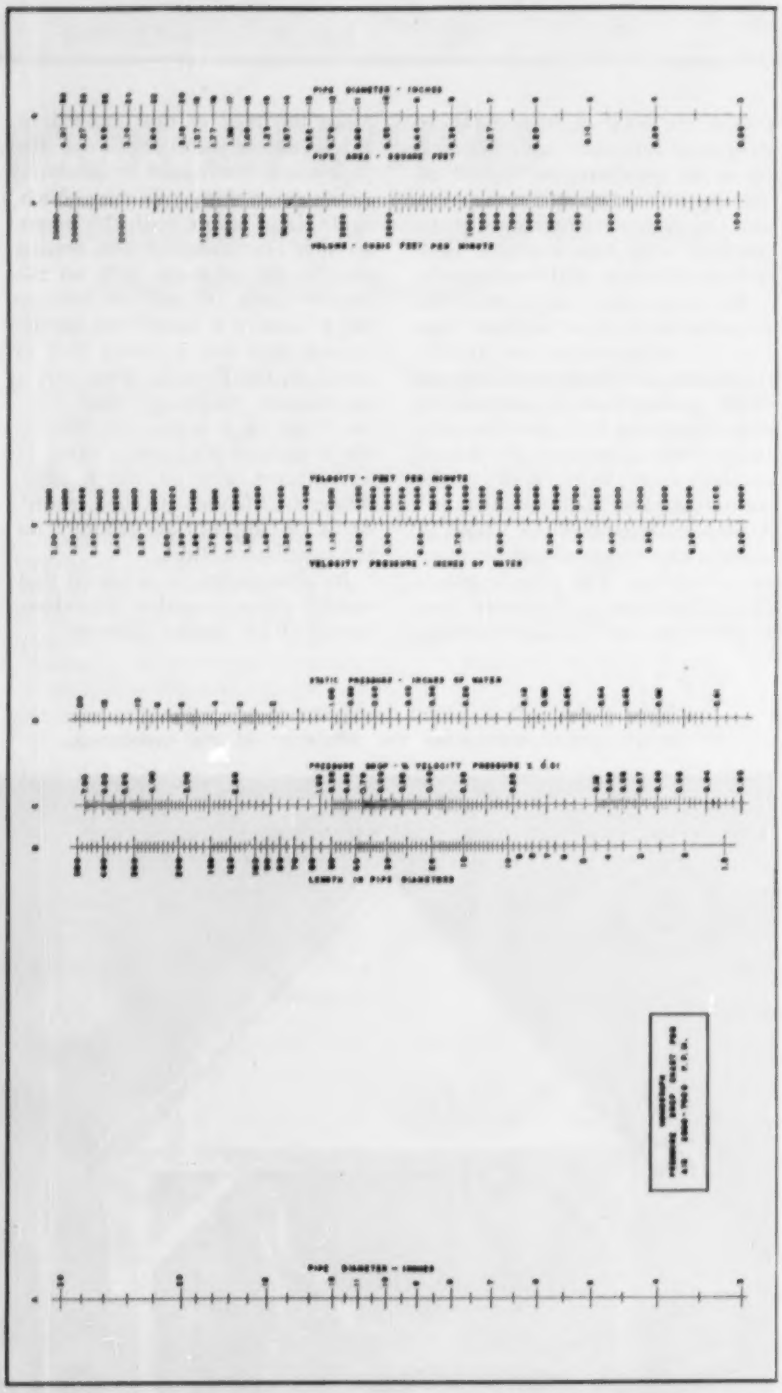
■ **Step 2:** Determine the amount of exhaust air needed and the entry loss of the hood or equipment. In the case of the rotary table blast, exhaust air requirements depend on the application, size of the machine, and the various components of the machine with data available from the manufacturer of the equipment.

For the purposes of this problem, manufacturer's data indicate that total air requirements are 5600 cu ft per min and the pressure drop up to the point where all components come together is 3.40 times the main branch velocity pressure. On the calculation sheet, write "3.40" in the column marked "Equipment Loss."

■ **Step 3:** Determine the length of straight pipe required and the number of fittings. The pipe length is 12 ft. The length of all pipe sections is given on the calculation sheet. Since the type of dust carried by this section of the system is fine, the pipe size is determined by assuming a velocity of 3600 ft per min, which, again, is in accord with the manufacturer's recommendations. Setting the straight edge on 3600 on the velocity scale (E) and on 5600 on the F scale, it is found that the required pipe size is about 16.9 as noted on the G scale. Since this is an odd size, the straight edge is set on 17 on the G scale, and 5600 on the F scale which gives a value of 3570 ft per min on the E scale. These final figures are then recorded in the appropriate columns on the calculation sheet.

By observation, it is found that one 90° elbow is needed. Therefore, record "0.19" under "Elbows."

The hood is the most important single part of any exhaust system. Its design largely determines the efficiency of the installation.



Nomograph incorporates several equations which aid in pipe design.

■ **Step 4:** Find the pressure drop through the straight section of pipe. Determine the number of pipe diameters of pipe in the section. This is found by dividing the number of inches of pipe by the number of diameters of pipe in inches. Thus, a 12-ft length of 17-in. diameter pipe would have:

$$\frac{12 \text{ ft} \times 12 \text{ in.}}{17 \text{ in.}} = 8.5 \text{ equivalent pipe diameters (all these figures are rounded to the nearest } \tfrac{1}{2} \text{ diameter)}$$

The pressure drop may now be found in terms of velocity pressure by laying the straight edge on 17 on pipe size scale A, 8.5 on scale B, and reading 0.142 on scale C. This value is then recorded under "Straight Pipe" on the calculation sheet.

■ **Step 5:** To find total pressures, enter 1.00 VP under the column "Velocity Head." Add all values. The sum yields a pressure loss of 4.73, in this particular section of pipe. In order to determine total pressure at this point, lay the straight edge on 4.73 on the C scale, and 3570 (the velocity in the pipe) on the E scale, and read the pressure of 3.75 on the D scale.

■ **Step 6:** Note the branch from the stand grinder in Section 2 of the system. It is necessary to size the branch to carry the volume of air required, and to develop up to the main a pressure drop equal to the main pressure at this point.

Record all equipment and fitting losses, which are as follows:

Equipment losses:

1.65 for the hood
0.38 for two 90° Elbows
Totol 2.03

Fitting losses:

0.19 for one 90° elbow
0.18 for one 30° take-off
Total 0.37

Minimum velocity of 4500 ft per min and minimum volume of 880 cu ft per min is recommended for each 30-in. wheel or a total of 1760 cu ft min. For a margin of safety use 5000 ft per min instead of 4500 ft per min. Lay the straight edge on 5000 on scale E, and on 1760 on scale F and read approximately 8 in. on scale G. Thus an 8-in. branch is suitable. Record this size. Seven ft of 8-in. pipe is equivalent to 10.5 pipe diameters, which is then recorded in the proper column.

Using scales A, B, and C, the loss for this section of pipe is found to be 0.21 × VP, and the total loss for Section 2 of the system in terms of velocity pressure is 2.61 (2.03 + 0.37 + 0.21).

The value of 1.0 × VP for obtaining total pressure is not recorded under the column "Velocity" in this instance, because the loss for the hood refers to total pressure which is already included. With certain hood forms, static pressures are shown instead of total pressures.

Since total loss (2.61) for the branch must equal the pressure in the main (3.75), lay the straight edge across 2.61 on the C scale, and 3.75 on the D scale, and the velocity (4790 ft per min is read on the E scale. From the E, F, and G scales it is seen that at this velocity the 8-in. pipe will carry 1670 cu ft per min which is sufficiently close to the suggested value of 1760 cu ft per min.

■ **Step 7:** Section 3 of the system is a straight run of pipe 8 ft long. Sum up on the calculation sheet the air volumes handled up to this point: 5600 cu ft per min in Section 1, plus 1670 cu ft per min in Section 2, yields 7270 cu ft per min in Section 3.

Select a good conveying velocity for the type of dust: 1400 ft per min should be satisfactory.

Using the E, F, and G scales it is found that an 18-in. pipe will carry the volume of air needed at a velocity of 4640 ft per min, which is higher than needed; a 10-in. pipe would have a velocity of 3750 ft per min, which is a little low; thus the choice of an 18-in. pipe.

Find the number of pipe diameters involved (by previous direction):

$$\frac{12 \times 8}{18} = 5.5 \text{ (rounded off).}$$

By use of scales A, B, and C the loss is found to be 0.091 VP. Set the straight edge on the E scale at 4150 (the air velocity in the pipe), and on 0.091 on the C scale; a loss of 0.10 will be read on the D scale. Add this value to the main pressure at the previous branch (3.75). The total main pressure is now 3.85.

■ **Step 8:** Since Section 4 is the same as Section 2 it is safe to assume that a branch of the same size can be used, recognizing that slightly more air will be drawn into the branch because of the higher main pressure: 3.85, as compared to 3.75 in Section 2. Since losses are equal, record the same values as for Section 2.

Since the total loss of 3.85 is equivalent at this point to 2.61 VP, the branch velocity is found by laying the straight edge across 2.61 on the C scale, and 3.85 on the D scale; a velocity of 4850 ft per min is read on the E scale. Using scales E, F, and G, the volume is found to be 1870 cu ft per min.

■ **Step 9:** As in Step 7, select a good conveying velocity near 4000 ft per min for Section 5 of the system. Since it is more desirable to be slightly high than low, the nomograph shows that a 20-in. pipe will carry 9140 cu ft per min (7270 + 1870) at about 4220 ft per min. This section is 6 ft long, which is equivalent to 3.5 pipe diameters. By use of scales A, B, and C the loss in the pipe is found to be 0.07 VP.

The pipe enters another main at this point at 90°, so that a loss of 0.19 for one full elbow must be allowed. The total loss is then 0.07 plus 0.19, or 0.26. At 4220 ft per min the total loss increases to 0.29 which, added to the last main value, gives a total main pressure at this point of 4.14-in. W.G.

Loss Due to Entry into Main*

Angle°	Loss	Angle°	Loss
10	0.06	35	0.21
15	0.09	40	0.25
20	0.12	45	0.28
25	0.15	50	0.32
30	0.18	60	0.45

* Loss as decimal fraction of branch VP.

From the design on page 56 it is seen that another branch converges at this point, and calculations are now made for its various sections. Leave two or three lines blank on the calculation sheet in case it is necessary to change the last section of pipe to adjust pressures.

■ **Step 10:** The objective now is to design the new branch, consisting of Sections 6, 7, and 8, in such a way that its total pressure loss will equal that of the branch already designed. More judgment will be required here than in any other phase of the design procedure.

First, size a pipe for Section 6 that will yield a pressure drop which, when added to that of Section 8, will match the pressure at the point of convergence with Section 5.

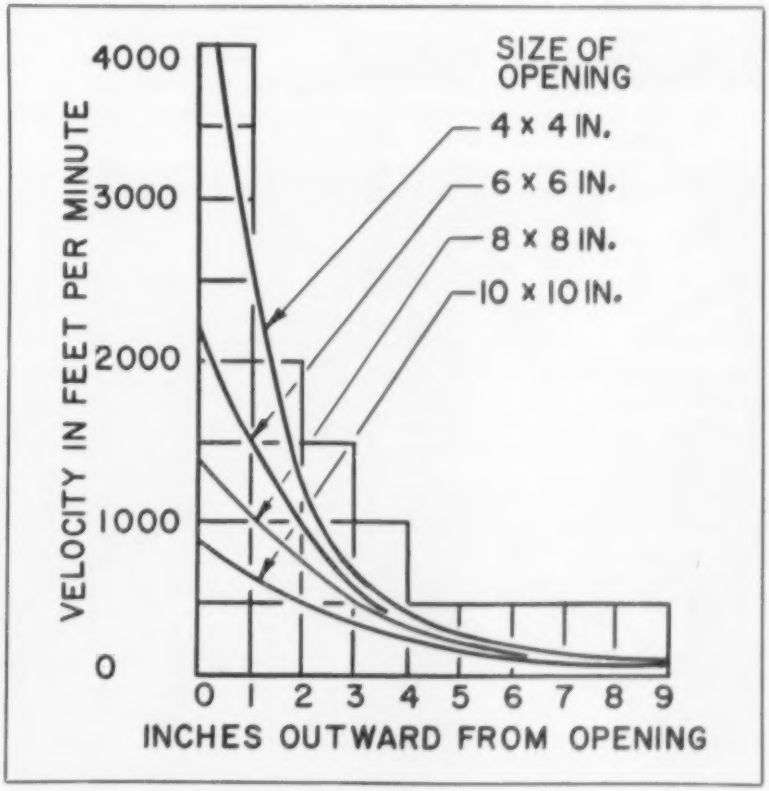


Chart shows velocities developed in front of four square openings.

Since the chipping bench requires 1600 cu ft per min, try sizing the pipe so that the air velocity will be about 5000 ft per min. The nomograph shows that a 7½-in. pipe conveys 1600 cu ft per min at 5230 ft per min. Eighteen ft of 7½-in. equals 29 pipe diameters. From scales A, B, and C the pipe loss is found to be 0.59. Total losses in the section are as follows:

Pipe loss	0.59
90° Elbow loss	0.19
Equipment loss	1.50
Total	2.28

Set the straight edge at 5230 on the E scale, and 2.28 × VP on the C scale; a resistance of 3.9 is read on the D scale. This is a reasonable figure, since it is close to 4.2, the pressure found at the point of convergence of the branch previously designed.

■ **Step 11:** Design Section 7 to match the pressure of the main: i.e., (3.9). Total losses in the section are:

Pipe	0.26
30° Branch take-off	0.18
90° Elbow	0.19
Equipment	1.50
Total Losses	2.13

As in step 10, the nomograph indicates that a velocity of 5400 ft per min will give a loss of 3.90 when the equivalent loss in terms of VP is 2.13. This results in a volume of 1650 cu ft per min, which is satisfactory for the chipping bench.

■ **Step 12:** Design Section 8. Find a pipe size that will give a loss of 0.24. (The loss in Section 7 plus the loss in Section 8 should equal the loss at the point of convergence (0.24 + 3.90 = 4.14). Select the pipe on the basis of a conveying velocity of 4000 ft per min. From the nomograph, it is seen that a 12-in pipe will carry 3250 cu ft per min at 4150 ft per min. The loss in this pipe is 0.37, which, when added to 3.90, equals 4.27. Since this is close to the desired value of 4.14, it is evident that another size would yield an unsatisfactory value.

Rather than attempt to lower the pressure in this entire branch, it is better to adjust the pressure in Section 5. By reducing the pipe size in Section 5 to 19-in., the velocity increases to 4680 ft per min, which results in a loss of 4.20 or only 0.07 less than the second main branch. The relationship is sufficiently close.

■ **Step 13:** Select the size of the main to the collector on the basis of a velocity of 4000 ft per min. The pipe must carry 12,390 cu ft per min—the volume from the main branches. A 24-in. pipe will do this (scales E, F, and G), and the total collector pressure required for the main is 4.74 in. W.G.

■ **Step 14:** Calculate for the tumbling mill as in Steps 3, 4, and 5. The result shows that the line requires 12.73-in. loss. The wide range in branch pressures eliminates the possibility of balancing by pipe sizing. Therefore, a blast gate must be installed in the lower pressure main to create an additional loss of 7.99 in. (12.73 − 4.74 = 7.99).

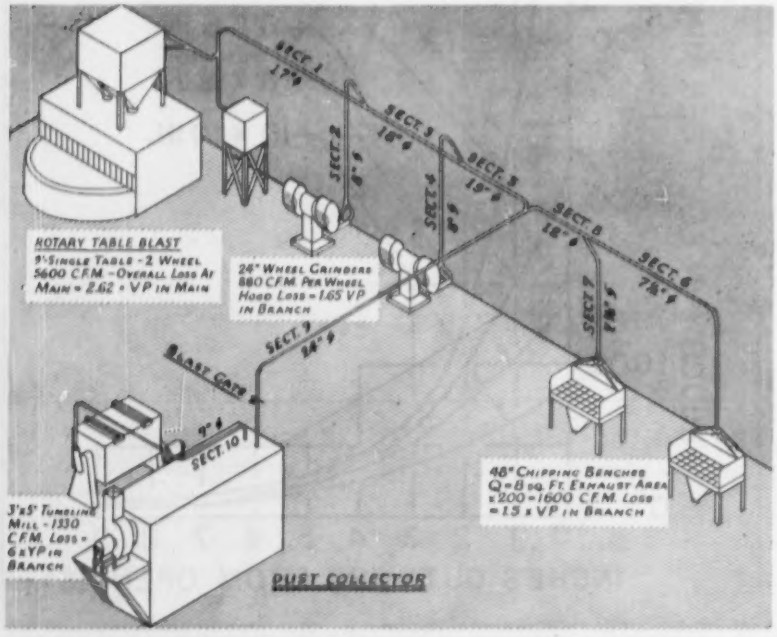
■ **Step 15:** The collector must have a capacity of 13,720 cu ft per min. Select a reasonable size for the pipe from the collector to the point of atmospheric discharge. The velocity may be kept low and is usually determined by the size of the fan discharge. The nomograph shows that a 30-in. pipe will carry 13,720 cu ft per min at 2810 ft per min which is satisfactory.

■ **Step 16:** When the fan is not furnished with the collector, the supplier of the fan does not allow for the pressure drop through the collector. The loss must be added to the total calculated pressure.

■ **Step 17:** Pressure drop calculations can now be given to the equipment manufacturer, but it should be emphasized that the values are for total pressure.

If the designer selects his own air-moving equipment, he must be careful about subtracting velocity pressure to obtain static pressure.

It is assumed in some fan tables that a recovery process is involved and that the designer has subtracted the velocity pressure on the discharge side of the fan. Where static pressure alone is calculated, it is assumed that the fan-inlet velocity is equal to the inlet velocity at the hoods, which is seldom true in an exhaust system. Therefore, as a basis for fan selection, if the total pressure of a system is known, determine the static pressure by subtracting the velocity pressure from the total pressure at the point of discharge to the atmosphere.



Balanced system was designed according to procedures outlined here.

SAND HANDLING

Control dust here and your biggest problem is licked

■ **Dust in the sand-handling system** is the biggest headache in maintaining good foundry environment. Yet it isn't difficult to design a simple and adequate exhaust system which can be installed easily in small and medium-sized foundries. This article tells how.

■ **Exhausters and collectors.** Stack fans or exhausters are by far the least expensive means for exhausting dust or fumes. But they are not collectors, arresters or precipitators and discharge all contaminated air to the outside.

For this reason it may not be permissible to use them without collectors in an exhaust system handling dust in areas subject to control regulations. They can, however, be used with advantage in handling steam and fumes in certain installations and especially in the case of comfort ventilation.

■ **Calculations.** An exhaust system consists of hoods enclosing the source of dust generation, branch ducts connected to the hoods, one or more main ducts joining the branches, a dust collector to remove the dust exhausted, and air-moving equipment to produce the necessary air flow through hoods and overcome resistance to the flow of air in the system.

There are two basic variations in the method of calculating pressure loss. Since many exhauster tables are based on static pressure across the fan, the entrance loss at the hood is sometimes used instead of the hood suction (entrance loss plus velocity pressure in the connecting branch).

The method illustrated here uses the hood suction as the loss through the hood, and has the following advantages:

1. Branch velocities often are higher than the velocity at the inlet of the air-flow-producing equipment. The inclusion of the higher velocity pressure counterbalances small acceleration and deceleration losses in the system and produces a result on the safe side.

2. By starting with the hood suction, pressure in the system can be immediately checked with a manometer against the calculated values in the system design.

■ **Simplification of total pressure calculation.** In order to simplify the

total pressure calculation of an exhaust system, variables have been eliminated by establishing fixed values to such items as the speed in feet per minute of air flow in the pipe, and also the hood suction at points of entry.

Note that the velocity of 3750 ft per min is generally applicable to sand handling systems. This value of 3750 ft per min has had rather general application in other types of exhaust systems in the foundry—except that it cannot be used for exhausting cleaning-room equipment.

The hood suction indicated for any given example is contingent not only on the fixed velocity but also on design of the hood, as well as on the flared entrance pipe.

■ **Modification of Air Volume Requirements.** Calculated air volume requirements and pressure loss may require some modification. These can be evaluated from the following data:

Capacity of air-moving or collection equipment should exceed calculated requirements by at least 10 per cent to provide reserve capacity for unforeseen dust or smoke conditions, leakage, and loss in operating efficiency. Exhaust volume requirements and resistance charts assume standard atmospheric conditions of temperature and a barometric pressure (68 F and 29.92 in Hg).

No corrections are required for variations of temperatures under 100 F or for elevations under 1500 ft.

In the case of altitude differentials, corrections must be made when elevation exceeds 1500 ft.

A simple formula for making this correction is to reduce the calculated pressure 3½ per cent for each 1000 ft above sea level. Thus, at 5500 ft elevation the correction factor would be approximately 19.25 per cent.

■ **Hood Suction Losses.** Hood suction losses in inches water gage are based on the formula "Suction equals 1 VP plus entrance loss," and are contingent on the flared pipe entry being 3 diameters in length and the entry angle 30°.

■ **Pressure Loss of an Exhaust Pipe System.** The pressure loss of any exhaust pipe system is determined by the "run of greatest resistance." This run, as a general rule, can be selected by analyzing the following factors influencing resistance losses of any path of air travel:

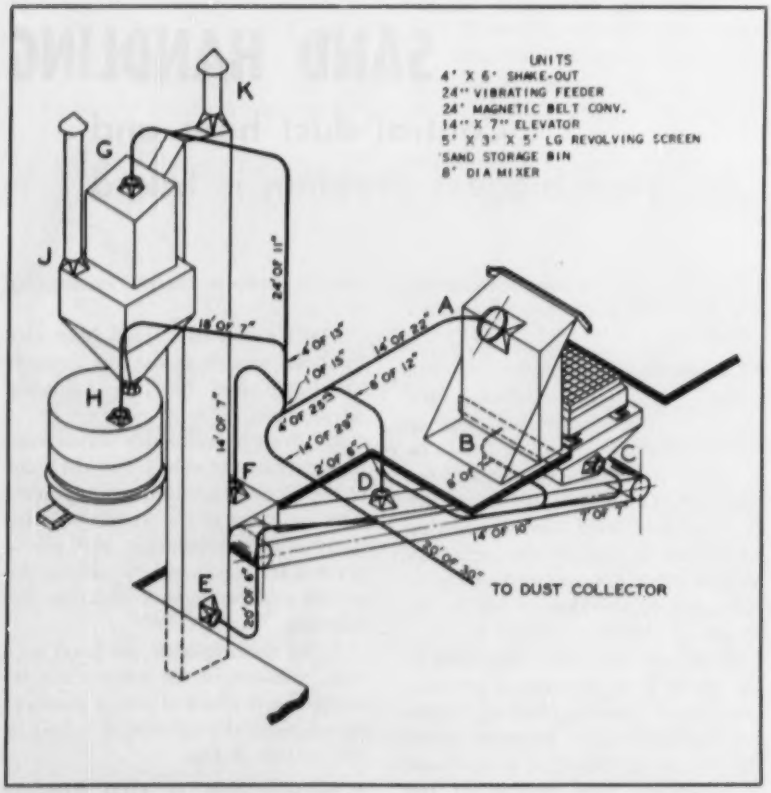
1. Distance of farthest hood from air-moving equipment.
2. Long runs of small diameter branch and/or sub-mains.
3. Hood suction loss at point of exhaust.
4. Number of elbows and fittings in run.

Thus, analyzing the piping example on page 58 it can readily be seen that the run from point B to the collector has a greater resistance than the runs originating at points

Exhaust Volume Requirements

Exhaust Point	Hood Suction	Required cfm	Pipe Size, in.*	Actual cfm
A	1.76	9600	22	9899
B	1.76	960	7	1002
C	1.28	1000	7	1002
D	1.28	700	6	736
E	1.28	665	6	736
F	1.28	1000	7	1002
G	1.28	2300	11	2475
H	1.28	1000	7	1002
J	Gravity Stack			
K	Gravity Stack			
		Total cfm		17,854

* The pipe size selected for the required cfm shall be the closest even size pipe, which is usually slightly larger than required. Pipe size selected, based on 3750 cfm velocity, then determines the actual cfm requirements.



Dust collecting system pictured here is same described in article.

A, C and D, as this run has the greatest hood suction, has more fittings, has the longest run of small diameter pipe, and is farthest from the collector. Run originating at point G can be eliminated—as this run has a lower hood suction, and the run of pipe is comparatively large. Likewise, run originating at point F can be eliminated, as it has the same hood suction, same number of elbows and the same diameter pipe—but a shorter run as compared with run originating at point H.

Similarly, a quick check of the runs originating at points E and H will indicate that the hood suction plus the resistance in small diameter pipes leading to the main will be approximately the same as or slightly greater than the hood suction alone at point B.

From the foregoing analysis it has been determined that the run originating at point B will be the run of greatest resistance and, therefore, it will be necessary to calculate this run only. If any doubt exists as to the run of greatest resistance, then the questionable runs should all be calculated. The table at upper right shows exhaust volume requirements.

Fan manufacturers' tables are made up on the basis of either total pressure, resistance pressure or static pressure. When the table being used is in terms of total pressure, deduct one velocity pressure from these readings to obtain static pressure for use in fan calculations. In fan charts reading TP or RP, the reading for the exhaust system can be taken directly from the resistance calculation (8.45 in.) in table at lower left.

EXHAUST VOLUME REQUIREMENTS

EXHAUST POINT	FIGURE NO	HOOD SUCTION	REQ'D CFM	+PIPE SIZE	ACTUAL CFM
A	12	1.76	9600	22"	9899
B	12 & 27	1.76	960	7"	1002
C	14	1.28	1000	7"	1002
D	5	1.28	750	6"	736
E	6	1.28	665	6"	736
F	2	1.28	1000	7"	1002
G	7	1.28	2300	11"	2475
H	10	1.28	1000	7"	1002
J	9	GRAVITY STACK			
K	4	GRAVITY STACK			
			TOTAL CFM		17,854

Table shows exhaust volume requirements for various points on sand-handling system illustrated on page 56. Once cfm requirements are known, designers should use the next largest standard size of pipe.

■ **Balancing an Exhaust System.** Since exhaust systems are designed to move a certain volume of air from a hood or dust-producing point in a system involving many such points, some means of control is necessary. In the so-called "balanced system" this is done at the design stage by adding artificial resistance at the low pressure points to balance the anticipated pressure loss at the other points. In systems designed on the basis of the "run of greatest resistance," the other runs must be provided with a means of equalizing pressures and volumes to this run.

Normally, slide-gate dampers or blast gates are installed in each branch where they enter the main or sub-main to be used for this control. To balance a system using the blast gates, start with the branch having the least resistance.

A 1/16-in. hole must be drilled near the hood and between the hood and the blast gate in each branch to allow a manometer hose to be held over it to measure the pressure. Adjust the blast gate on the branch until the pressure reads slightly less than the design figure on this branch. Do the same on the next lowest branch. Near the center of the system use the design figures for setting the blast gate.

When the complete system of branches has been checked in this manner, some variation will be found from the original settings. Close the blast gates where the pressure shows the highest readings and open the gates showing under design figures.

When all branches have the same pressure, lock the blast gates in position with rivets or bolts to prevent further manipulation and maintain the proper balance.

Run of Greatest Resistance ("B" to Collector)

Description	Length of Pipe in Feet: Straight Run	Elbows* No.	Elbows* Equiv. ft Pipe	TOTAL LENGTH ft	Resistance, inches: PER 100 ft	Per Run	Governing Resistance
Hood Suction	For Resistance See Figs. 12 and 27						1.76
7 in. Pipe Run	8	2	14	22	2.81	0.62	0.62
10 in. Pipe Run	14	2	22	36	1.81	0.65	0.65
12 in. Pipe Run	8	2	28	36	1.45	0.52	0.52
25 in. Pipe Run	4	0	—	4	0.60	0.03	0.03
29 in. Pipe Run	14	1	40	54	0.50	0.27	0.27
30 in. Pipe Run	20	0	—	20	0.49	0.10	0.10
Weather Cap & Stack							0.50
Collector	Resistance Assumed. Check with Mfgr. of Collector						4.00
						Total Pressure	8.45

NOTE: Total pressure is the algebraic sum of static pressure plus velocity pressure. Therefore, if the fan or exhauster ratings are given in manufacturer's fan tables as static pressure, deduct one velocity pressure (0.88 in. for 3750 fpm) from total pressure. This static pressure equals 8.45 in. minus 0.88, or 7.57 in.

MOLDING and CORE MAKING

Sand and smoke are easily handled

■ **The hygienic problems** involved in shell molding tend to be more of a nuisance than a health hazard. Similarly, dust concentrations and other hazards of core making operations are safe if recommended operating procedures are applied.

The methods of sand preparation are basically the same in all branches of the industry whether mechanized or not and the usual safety precautions apply. They are discussed elsewhere.

■ **Core making.** Dust concentrations in most operations are safe because sand particles are large and the sand is necessarily in a tempered condition. However, certain hazards may arise which are not inherent in the actual forming of the cores.

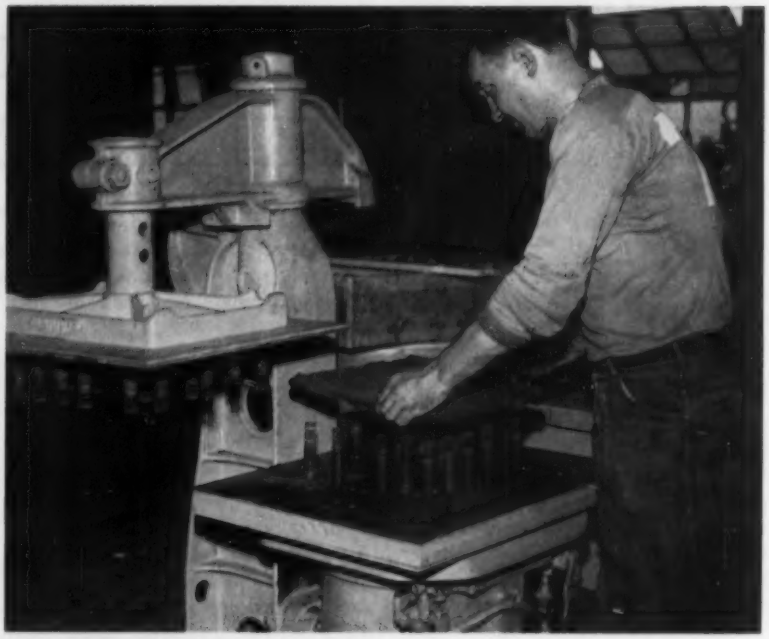
■ **Mixing ingredients.** Most of the materials are nontoxic—a few are skin irritants. The normal operation of a core sand muller is often dusty and a nuisance.

When an exhaust hood is required for any reason, it may be designed according to the method previously explained. In lieu of exhaust, dust can be satisfactorily controlled by totally enclosing the muller.

Binders are often shipped in paper bags from which they are emptied into the core sand mixer. If such bags are punctured at the bottom in order to admit air, the partial vacuum in the bag caused by the displaced material is broken. This procedure greatly reduces escaping dust.

The operation of mixing ingredients in modern foundry practice usually is not hazardous to health. When resins in powdered form are used as binders, a dermatitis hazard may exist for susceptible persons.

Some solvents used in sand mixing are flammable and consequently all electrical equipment in the area should be explosion proof.



Shell molding operations in foundries have a low degree of hazard.

■ **Blowing.** Blowing presents no industrial hygiene problem. A safety hazard may be present, however, if boxes and flasks are not tightly sealed.

■ **Spraying or dipping.** Washes are composed of a variety of materials suspended in various liquids such as water, core oil, gasoline, alcohol and naphtha.

Of the common suspensions silica and asbestos are the most important from a health standpoint.

Materials sometimes added to washes to give a specific color may contain lead and thus where the wash itself may be safe, the color ingredient may be poisonous.

Dipping is not considered to be hazardous and vapors from organic solvents, if used, may be satisfactorily controlled by general ventilation.

Spraying with washes containing toxic substances such as silica and lead is always hazardous even though the material is suspended in water. Spray guns atomize the suspension so that in effect a toxic and respirable aerosol is formed. A control air volume of 150 cu ft per min per sq ft of hood opening is recommended.

■ **Core baking.** Acrolein gas always forms because of thermal decomposition of core oil during baking. Because low atmospheric concentrations of acrolein are intolerable by man, removal of core oil fume by proper methods of exhaust is essential.

■ **Sources of energy.** Coke and coal are used in the older types of equipment from which fume usually

escapes. Frequently some form of exhaust hood must be installed over the oven doors to control leaking gases.

With modern equipment, core baking presents two minor problems: (1) flammable condensate in stacks; (2) fume from hot cores after removal from ovens.

Condensate in core oven stacks can be eliminated by preventing effluent gases from reaching the dew point by using double-walled stacks or by increasing the stack discharge velocity. The latter remedy increases operating cost by forcing excess secondary air through the core oven; hence an insulated stack is preferred.

When hot cores are removed from ovens, in many cases irritating fumes continue to be evolved until the core cools to dew point temperatures. This problem can be solved by placing the core racks in a complete or partial enclosure which is under sufficient vacuum to prevent escape of fume. An in-draft to all openings of 150 ft per min is recommended; hence the more complete the enclosure the less air required.

▪ **Grinding.** Exhaust ventilation is effected by partial enclosure. Minimum duct velocities should be no less than 3750 fpm, and recommended exhaust volume is 200 cfm per sq ft of table area.

▪ **Shell molding.** Health hazards directly associated with shell molding are not potentially severe.

Non-hydrolyzable silicones used as mold release agents are of a very low order of toxicity, hence hazards from handling them are minor.

The solvent in which silicones are dispersed may also constitute a hazard.

▪ **Toluol** is a more powerful narcotic than benzene and its acute toxicity is greater.

▪ **Acetone** has a relatively low order of toxicity. Reports of industrial poisoning from acetone are rare.

▪ **Carbon tetrachloride** is very poisonous and is easily absorbed by the mucous membranes, the lungs, and to some extent by the skin.

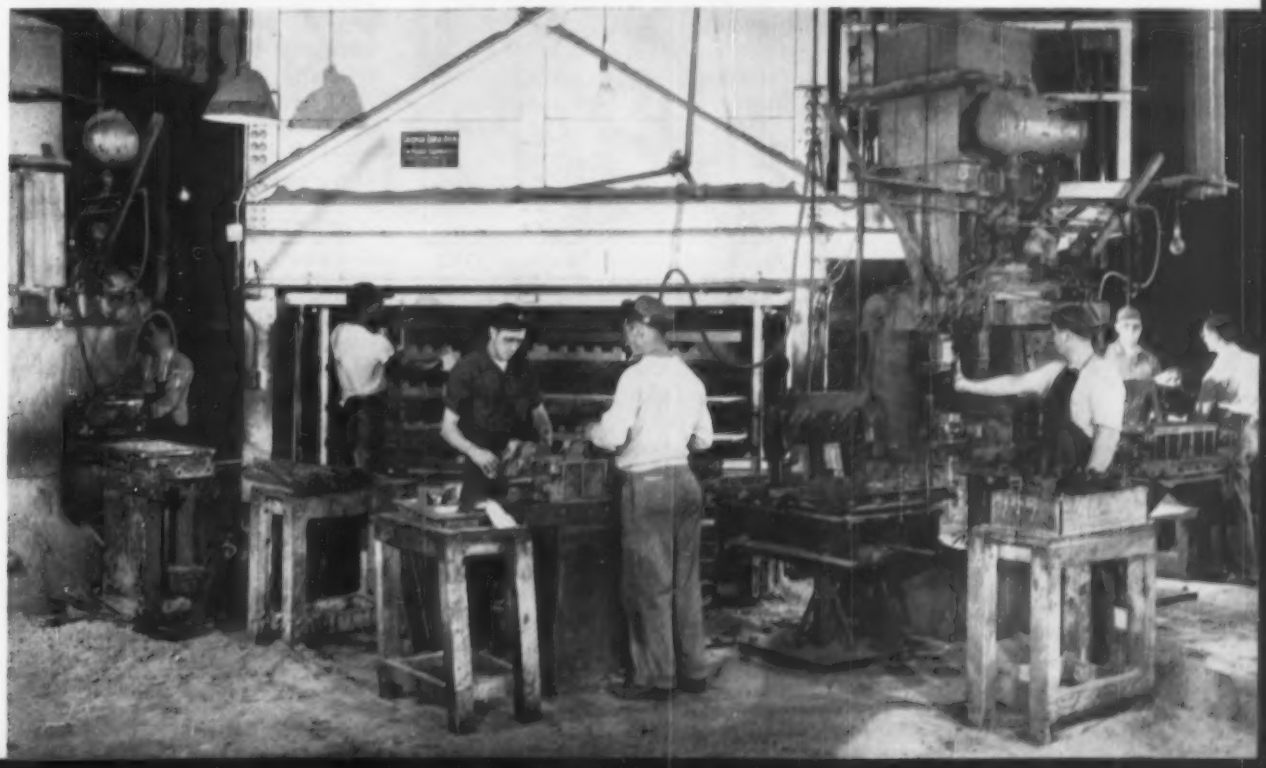
▪ **Irritation from resins.** In dry mixing resin and sand, dust is produced and a hazard from silica may exist if atmospheric concentrations are great enough. Resin dust is an irritant and sensitizer and can cause dermatitis and lung and eye irritation. Direct physical contact should be avoided.

Dust produced during mulling can be controlled by exhaust ventilation or by using a wetting agent to minimize dusting. Kerosene in 0.25 per cent weight additions is satisfactory for this purpose. For small batch mixers, a cover over the opening of the mixer frequently serves as a satisfactory method of dust control.

The type of material used to back up the shell has a relationship to industrial hygiene. Round metal shot presents a serious safety hazard if spilled. Round shot has a tendency to roll causing the halves of the shell to separate slightly. This results in a thin fin on the casting at the parting line, necessitating grinding and thus introducing a secondary dust problem.

If lead rather than steel or copper shot is used, the possibility of a lead hazard exists. A preferred method of hygienic control consists of gluing the shell halves together, using only enough back up sand to prevent chilling. Castings can then be shaken out on exhausted shakeout machines.

Core making is a safe operation but some problems exist in associated activities not inherent in the process.



MELTING and POURING

Exhaust hoods, stacks and enclosures control the fumes

Editor's Note: *This section is concerned only with in-plant environment and does not consider the problems of external air pollution which may arise by following the ventilating methods described here. If stack fumes must be collected, the roof ventilators and gravity stacks suggested cannot be used.*

■ **The health hazard** connected with melting and pouring depends on the type of metal being processed. The degree of the hazard determines the extent of ventilation required.

Often the volume and nature of the fumes produced by a cupola do not require an exhaust hood over the tapping spout when:

- Tapping is intermittent.
- Concentration of fume during tap-out does not exceed the maximal allowable concentration except in the immediate vicinity of the spout.
- The principal constituent of the fume is iron oxide, which is physiologically inert.
- The cupola operator can easily avoid the direct plume of fume.

On the other hand, local exhaust ventilation is sometimes necessary even though the fume from the metals being processed is harmless. Example: the fume from an electric-arc furnace melting manganese steel is principally iron oxide. Yet the volume of fume is sufficiently concentrated to produce in exposed personnel a condition of the lungs called siderosis. Not only the melters but also the crane operators may be exposed, especially if the crane cab and furnace are on the same side of the bay. Furthermore, the dense volumes of fume produced during melting and tapping often so reduce visibility that cranemen cannot operate safely.

When the heat contains poisonous metals such as lead or beryllium even in trace amounts, some form of ventilation is nearly always necessary in order to prevent occupational disease.

Thermal updrafts can be used to advantage when designing hoods, especially in designing exhaust ventilation for melting operations, because the temperatures involved are of the order of 2000 F or higher. Convection air currents produced by such temperatures frequently yield velocity pressures so great that fans are not required for suction.

When designing exhaust ventilation for melting and pouring equipment, it is helpful to consider ventilation as an air problem—not a fume problem.

Fume, of itself, is unable to move in any direction unless it is convected by air or gases which impart kinetic energy to the fume. Thus, by controlling the direction of flow of air or gas, the dispersion of fume is automatically controlled. This principle enables the designer to estimate whether a simple cover, baffle, diverter, hood or enclosure will be effective. For example, a canopy hood located near a drafty opening, such as a door or window, will not be effective unless the draft through the opening can be neutralized by baffles or other devices.

A lift truck passing an exhaust opening at the rate of 5 mph (440 fpm) can produce cross currents of air that may nullify the draft velocity of an adjacent hood. In such cases, if the air-flow pattern is distorted momentarily and infrequently, no harm may result. But if the interference is continuous or frequent it is necessary to provide partitions or baffles, or to increase the control velocity of the hood in order to overcome the air disturbance caused by the moving vehicle.

MELTING

■ **Gravity stacks.** When a gravity stack is used to control fumes from melting equipment it should be kept in mind that the volume of air carried by such stack is directly proportional to:

- Stack cross-sectional area.
- Stack height.
- Temperature differential between stack inlet and outlet.

Thus, if the proper size stack cannot be installed because of limitations of space and if the temperature gradient in the stack is insufficient, draft must be induced by mechanical means.

Gravity stacks are suggested here only when the source of fume is hot enough in most cases to produce adequate draft, and it has been assumed that the proper stack size can be used.

■ **Lift-out furnaces** usually are installed in a pit, and hence are sometimes called pit furnaces. Used customarily for melting non-ferrous metals, pit furnaces require exhaust ventilation in most cases.

An enclosure is an effective way of controlling fumes from pit furnaces. The exhaust volume should be of the order of 2000 cfm—sufficient to maintain an in-draft of 100 fpm through all openings when access doors are open. This velocity is usually attained with a gravity stack.

■ **Tilting furnaces** are better exhausted by complete enclosures which have a rear access door for charging and a counterbalanced front panel that can be raised for pour-off. Such a hood requires an exhaust volume of only 2000 cfm per furnace. A gravity stack will carry this volume in most cases.

■ **Stationary furnaces** are used for "holding" or melting non-ferrous metals. In aluminum foundries, these furnaces are useful for holding a

melt which requires further treatment before casting. Crucibles may be lifted from the furnace or the molten metal ladled directly from it.

A simple enclosure with gravity stack affords adequate control of fume.

▪ **A reverberatory furnace** has a vaulted ceiling that deflects flames and heat toward the surface of the charge to be melted. Flame, introduced at one end, passes over the charge toward a stack at the other end. During melting, fumes are conducted through the stack and no other ventilation is needed.

If poisonous metals such as lead, cadmium, beryllium, etc., are melted in the furnace, the tapping spout must be exhausted. A simple canopy hood close to the tapping spout will effectively control fume during pour-off. An air velocity of 150 fpm across the face of the hood is sufficient but an exhaust fan is required in most cases in order to develop adequate draft.

▪ **Stack charging furnaces** are usually constructed with an oblong hearth which terminates in a short flue. The furnace is tilted along the longitudinal axis for pour-off. Most stack charging furnaces are of the reverberatory type, i.e., flames introduced at one end are deflected by the vaulted roof and the products of combustion escape through the charging stack.

A gravity exhaust pipe connected to a canopy hood mounted above the furnace stack provides adequate control of fumes emitted from the charging end of the furnace. The hood must be designed with an access door for charging.

▪ **Barrel furnaces,** so called because of shape, rotate continuously during melting. Flame is introduced at one end, and fumes are emitted at the other end. Fumes blown from the furnace retain their directional effect for a considerable distance from the point of emission. Thus barrel furnaces are a source of excessive atmospheric contamination unless adequate control measures are applied.

Complete enclosure of the furnace is recommended. When designing the enclosure, provision must be made for ease of charging, pour-off, and maintenance. The heat developed by barrel furnaces is sufficiently intense to produce adequate draft by gravity.

▪ **The kettle furnace** is easily exhausted by a simple canopy hood connected to a gravity stack. During melting the pouring spout faces upward, thus directing fume into the hoods.

The hood face area should be large enough to provide control of contaminants during pour-off and it should be suspended close enough to the furnace to overcome the influence of disturbing cross drafts.

This type of hood can be designed for access by monorail, bridge crane, or lift truck if suitable openings for bridge crane cables or monorail track are provided. The hood is not effective if the spout of the furnace is allowed to remain in a horizontal position during melting.

▪ **Rocking furnace.** A canopy-type hood may be used effectively to control fumes from a rocking furnace during the melting cycle but during the pouring operation a canopy hood does not capture the effluent completely. Unless the furnace is used only occasionally and the charge made up of nontoxic metals a canopy hood is not recommended. An exhaust volume of 2500 cfm per furnace and mechanical draft are required.

A more complete enclosure will provide better control, especially during pour-off, and gravity stacks are usually adequate for exhaustion of fumes.

▪ **Electric low- or high-frequency induction furnaces.** Induction furnaces may be exhausted by one of the methods previously suggested for fuel-fired furnaces.

The shape of the furnace, operating procedures and plant layout will determine the type of ventilation to be selected.

When induction furnaces are used

Hood controls fume problem at melting station. When hood is properly designed the foundry air will not be contaminated by these fumes.

to melt nontoxic alloys, fume control by general ventilation (dilution ventilation) may be satisfactory.

■ **The electric arc furnace** is used extensively in steel, gray iron, malleable, and occasionally in nonferrous melting. Dense fumes emitted from the furnace during melting and tapping are best controlled by local exhaust.

A hood mounted on the roof ring provides excellent control of contaminants with a minimum air volume of 2,500-40,000 cfm depending on size of furnace. By means of a slip connection to the exhaust duct, suction in the hood can be maintained even when the furnace is tilted for tapping. Skirts over the pouring spout and side-charge door effectively capture fumes during all phases of the melting cycle.

■ **Cupolas.** Insofar as in-plant contamination is concerned, the methods of ventilating fumes from cupolas are basically the same, whether the cupola be hot blast, closed top, or open top.

The tapping spout, forehearth, and sometimes the charging door are the sources of in-plant atmospheric contamination from cupolas.

A simple roof ventilator provides satisfactory control of fumes when non-toxic metals compose the heat or when tapping is intermittent.

A canopy hood with side baffles is usually necessary for adequate fume control when non-toxic metals compose the heat but tapping is continuous into forehearth or bull ladle.

An exhaust velocity of 150 fpm into all openings of the hood is required. A gravity stack is satisfactory in most cases.

A canopy hood with side baffles (or equivalent enclosure) and mechanical draft are always necessary to control toxic metal fumes issuing from cupola spouts during tapping. A minimum exhaust velocity of 150 fpm into all openings of the hood is recommended.

Sometimes products of combustion and metallic fumes are emitted from the charging door of cupolas. Poor charging practice usually is the cause of such emissions; however, except for the danger from carbon monoxide no health hazard results if the cupola is mechanically charged or if the heat is composed of nontoxic metals.

■ **Inoculation of nodular or ductile iron.** During treatment of molten iron with magnesium or other inoculating substance, dense clouds of fume are generated. The reaction is exothermic and produces intense heat and light. One pound of magnesium yields on burning about 11,000 BTU's. Wave lengths of light are given off in the ultraviolet, visible, and infra-red spectrum.

A preferred method of reducing fume during inoculation consists in the use of proprietary magnesium alloys which produce far less fume than pure magnesium. Alloys in more general use are combinations of nickel, ferrosilicon, cerium, and silicon with magnesium.

A local exhaust hood is recommended for control of fume. By means of an extensible exhaust pipe of telescopic type a funnel is located over the tapping-spout delivery point. One terminal of the exhaust duct is connected to a fan on the roof giving 25 to 30 cfm per lb. of iron. The system may be operated only during inoculation of the melt.

■ **Slag wool** is a physiologically inert silicate and as such requires no exhaust ventilation. In the interest of better housekeeping, however, prevention of dispersion is recommended.

A diverting baffle installed near the slag opening of the cupola may be used to deflect slag into a water trough, thus preventing formation of the wool.

■ **Cupola lining.** Lining the cupola may be hazardous to health if the materials used contain silica in the form of sprays or in other condition. When chipping out old lining for repair patching, high concentrations of dust are formed in the confined space of the stack. Dust exposures may be more or less severe depending on the duration of the work and the percentage of free silica or other toxic material in the dust.

Linings of cupolas used for melting metals such as lead, beryllium, etc., are coated with poisonous metallic oxides. Thus, in addition to the hazard from silica dust, the operation of lining repair may also involve exposures to other materials.

A respirator or a supplied air helmet approved by the U. S. Bureau of Mines for the particular dust involved should be worn during the dusty phase of lining repair. This is a preferred method of protection against dust exposures.

The practice of placing a salamander in the cupola to temper air in cold weather is unsafe and condemned.

POURING OPERATIONS

■ **Preheating ladles.** Ladles are customarily preheated by oil or gas fired burners. In most cases dangerous concentrations of the gas in the general foundry atmosphere are not reached even when some carbon monoxide is formed from combustion of ladle heater fuels.

When ladles are heated in confined spaces occupied by plant personnel or when crane cabs are located directly above the ladle heater station, local exhaust ventilation is recommended.

If there is no danger from carbon monoxide fumes, preheaters for ladles used to pour nontoxic metals require no exhaust.

Preheaters for ladles used to pour metals containing toxic materials, e.g., lead, beryllium, etc., always require local exhaust hoods unless the preheaters can be isolated from working areas in such manner that plant personnel are not exposed to injurious fumes.

Local exhaust hoods for ladle heaters will operate by gravity except under unusual circumstances.

■ **Bull ladle to pouring ladle.** Dense clouds of fume frequently are evolved when molten metal is transferred from bull ladle to pouring ladle. The method of exhaust (local, intermediate, or general) depends on the nature and volume of the fume produced.

One of the hood forms previously suggested should provide satisfactory control of the fume in most cases. Where hoods take the form of complete or partial enclosures,

gravity stacks produce sufficient draft unless the surrounding area is under negative pressure.

▪ **Skimming pyrometry station.** For innocuous metals, general ventilation of the skimming and pyrometry stations is adequate.

Insofar as toxic metals are concerned, local exhaust ventilation is recommended in all cases unless the ladle is skimmed under an effective furnace hood.

When it is impractical to skim under an existing furnace hood or enclosure, however, local exhaust ventilation at the skimming and pyrometry station is necessary.

▪ **Ladle to flask.** Transporting ladles from melting zone to pouring station requires no exhaust other than general ventilation if the melt is composed of nontoxic metals.

Transportation of ladles containing poisonous materials on the other hand may result in severe exposure to injurious fumes. This is especially true when ladles are transported by hand, lift truck, monorail crane and walking bridge crane.

A simple steel cover prevents escape of fume from the ladle and thereby affords satisfactory control. Where practical covered ladles of the commercial type are preferred.

If the monorail crane can be electrified, an exhaust hood fitted to the bail of the ladle provides excellent control of fume not only while transporting but also while pouring metal. A fan mounted on the trolley and connected to the hood by flexible tubing blows fume from ladle to roof where the contaminant is removed by roof ventilators or monitors.

To prevent damage to the fan and tubing from the intense heat of the melt, sufficient air must be exhausted. The rate of ventilation needed may be determined from published curves.

▪ **Pouring station.** In production pouring, where molds can be brought by conveyor to a central pouring station side hoods provide excellent control.

If molds are poured on a roller conveyor but not at a fixed station, a local exhaust hood is one of the most inexpensive and efficient methods of controlling pouring fumes. Canopy hoods are seldom satisfactory unless cross-air currents in the pouring zone are negligible.

Canopy hoods, if used for exhausting fumes from pouring should have a minimum control velocity of 200 fpm across the hood face.

In jobbing shops, where castings vary in weight from a few pounds to several tons, hooding is impractical unless the molds can be brought to a central station for pouring. In the case of fumes from nonpoisonous metals, general ventilation usually is sufficient if canopies are installed over the pouring zone as previously explained.

▪ **Centrifugal casting.** Control of fume from centrifugal castings operations does not differ from that required for other methods of casting. Whether the casting machines are singular or in longitudinal rows the control of fumes is based on principles of engineering already explained. Hoods for centrifugal casting machines, regardless of form, should have a minimum air control velocity of 150 fpm at the point of fume generation.

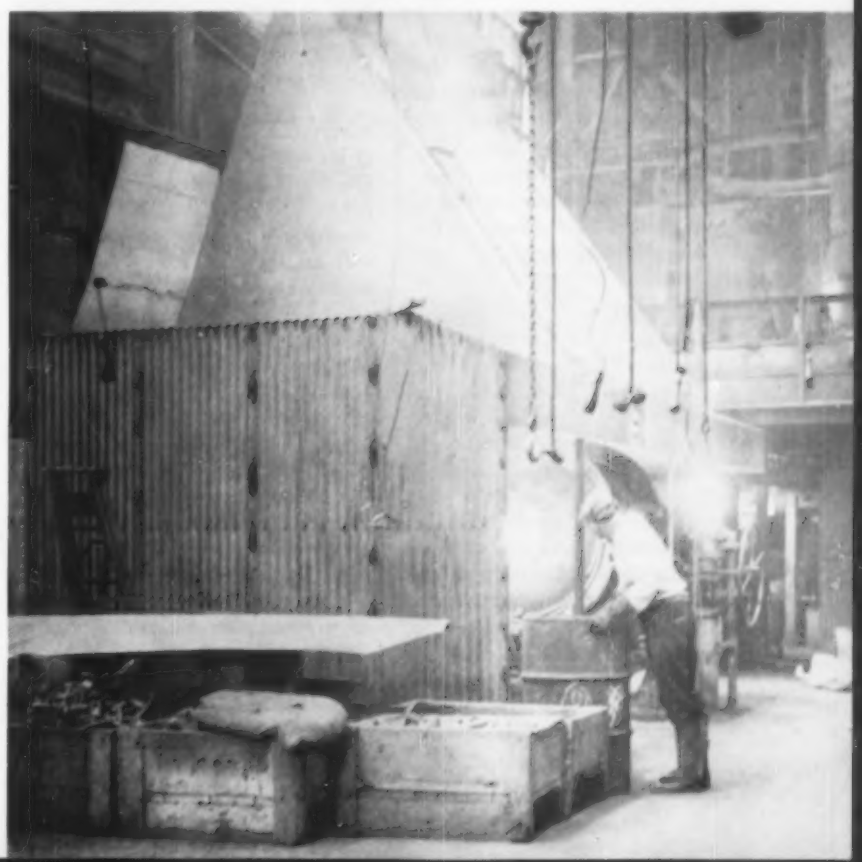
Remember, the methods of exhausting fume from melting and pouring operations described previously are suggestions only. The designer may find it necessary to alter the hoods to fit his particular circumstances.

Caution! When using fans to induce draft in any type of hood controlling metal fumes, the designer should not use motors that are located in the hot gas stream because of danger of burning them out.

Venturi ejectors are not very efficient and the cost per cubic foot of entrained air is high.

It should be re-emphasized that the requirements of regulatory authority in any locale must be complied with regardless of the recommendations or suggestions offered in this manual.

Ventilation is a must for this furnace. Exhaust volumes must be carefully figured but when properly engineered, enclosure solves problem.



RADIATION

Air movement is only a fraction of the answer; shielding solves the major problem.

■ **Some foundry jobs** are uncomfortable not because of high air temperature but because of radiant heat. The difference between the two is often overlooked. The measures which will control high air temperatures will not control radiant heat.

The four major factors of the physical environment that directly influence comfort are: (1) air temperature; (2) relative humidity (moisture in the air); (3) air movement (velocity of air blowing on a person); (4) mean radiant temperature of surrounding surfaces.

■ **Air temperature** is the popular index of comfort. Sometimes it is a good index—but only if the humidity is low, if the air is still, and if there are no sources of excessive radiant heat present.

■ **Humidity** is the next best recognized factor in comfort. The assertion, "It's not the heat—it's the humidity!" is being given more and more credence.

■ **Air movement** is important not because it lowers the air temperature but because it accelerates evaporative cooling—the drying of perspiration—which is man's only device for cooling himself.

■ **Radiant heat** is recognized in many of its aspects. On a hot sunny day people walk on the shady side of the street. They have blocked off the rays from the sun, and this makes them more comfortable — although the air temperature in the shade is scarcely lower than that in the sun.

Many foundries, however, have failed to shade their workers from similar invisible infrared energy. Yet control of radiant heat is invariably less expensive than applying convective ventilation.

Radiant heat is a form of electromagnetic radiation of relatively long wave length. Light is exactly the same form of radiation but of shorter wave length. Radiant heat is not effective until it falls on some object that will absorb it. It travels through air without heating it. Blowing air across a beam of infrared does not affect the air at all. Fans, blowers and air jets cannot deflect radiant heat nor keep it from falling on a person.

When infrared falls on some object it is absorbed or reflected depending entirely on the surface of the object. Polished metals are good reflectors.

Most common objects, however, are poor reflectors of infrared which means they absorb most of the heat falling on them. Color makes little difference; white reflects most of the visible light but against infrared it is no more reflective than is black. Aluminum paint can reflect as much as two-thirds of incident infrared. Aluminum sheet or foil reflects 90-95 per cent of the infrared.

An object absorbing the infrared energy falling on it becomes heated. If the object is a man, he gets hot. However, man is a good radiator and if surrounding objects are at a lower surface temperature than he is he will reradiate to them. But if his surroundings are at a higher temperature than a man's skin (92 F in winter, 95 F in summer), he accumulates heat and his temperature goes up.

How can the existence of a radiant heat problem be determined?

■ **Globe thermometer.** The ordinary thermometer is designed to indicate air temperatures. It does not react reliably to radiant heat that falls on it. However, if its bulb is surrounded by a thin-walled, hollow metal sphere painted flat black on the outside, the sphere will absorb nearly all the radiant energy reaching it. The thermometer will respond to this, in addition to the room air-temperature. Such an instrument is called a globe thermometer.

■ **Air temperature and humidity.** To learn the true air temperature, the bulb of a second thermometer must be shielded from radiant heat. This device is called a shielded aspirating thermometer. An improvement is to place a wet-bulb thermometer in it beside the dry bulb thermometer.

■ **Air velocity.** Air velocity is measured by any one of several different types of instruments which are commercially available.

With these four instruments — shielded dry-bulb and wet-bulb thermometers, globe thermometers, and air velocity meter—any industrial environment can be studied for its effect on personal comfort. The relative importance of radiant heat and heat carried by convection can be determined easily.

■ **Problem.** Assume the mean radiant temperature of the surroundings (mrt) is as much above the globe thermometer reading (t_g) as the latter is above the air temperature (t_a). Calculate the **mrt.**

■ **Answer.** The elevation of **mrt** above temperature (95 F in summer) will represent that part of the external heat load falling on the man, that is **radiant** heat; and the elevation of the air temperature above 95 F will represent the convective component.

■ **For example, suppose—**

Mrt=
130 — 110 = 20°
110 + 20 = 130°
= 150°

Heat transferred by convection = 110 — 95 = 15

Heat transferred by radiation = 150 — 95 = 55

Total 70

Convection component = 15/70 =21%
Radiation component = 55/70 79%
Total 100%

Thus 79 per cent of the heat load at this location is radiant heat, while only 21 per cent is heat carried by convection, or hot air.

In this example, blowing air around the room or introducing cooler outdoor air is not going to reduce the radiant heat load. For the least possible expenditure and for the quickest results the radiant heat must be attacked directly.

■ **Heat balance.** The human body, like any physical body, exchanges heat with its environment in accord with fundamental thermodynamic principles. These principles apply with equal validity to all persons. This does not mean that everyone exposed to a given thermal environment will have exactly the same feelings of comfort or discomfort. One person may be working harder than the other, thus producing more heat units that have to be dissipated. One may have a more ample perspiring mechanism than the other, etc.

The body receives heat from three sources: the heat produced **within** the body through work (metabolism), and heat transferred **to** it through convection and through radiation. This heat must all be disposed of by the cooling that comes from evaporation of perspiration. If it is not, body temperature will rise. **After a rise of only a few degrees the person is in for trouble.**

■ **Measures of "Comfort."** Many efforts have been made to combine the four environmental factors into a single index of comfort. By studying the reactions of large numbers of people under controlled laboratory conditions, where each would report, "This situation is 'comfortable'; and that is not," the **effective temperature scale** was derived.

Use of effective temperature will help a plant operator take some of the guesswork out of his heat problem. He can judge his own heat conditions in a way that is impossible if he only has before him the four separate environmental readings (globe temperature, dry- and wet-bulb temperatures and air velocity).

All the ventilation in the world wouldn't affect infra-red radiation from newly poured flasks—but shielding solves the entire problem.

■ **Control.** Radiant heat can be controlled by (a) lowering the temperature of the source, (b) reducing the emissivity of the source (energy radiated depends not only on temperature of the source but also on how nearly it approaches a 'black body,' and by (c) interposing a shield or screen between the source and the man so that he is in an infrared "shadow."

The surface temperature of the source can often be lowered by applying conductive insulation, as in the case of a furnace or oven wall or by operating the source at a lower temperature. The latter, however, is seldom permissible.

The emissivity of the source can be lowered by sheathing or coating it with sheet aluminum. Thickness of the coating is of no account. **The thinnest aluminum foil pasted to asbestos board panels surrounding a fire box will reduce the radiated heat 10-fold.**

Structural steel members will radiate less heat, for the same metal temperature, if they are painted with aluminum paint and they do not radiate as much heat for a given temperature as oil-painted steel.

■ **Radiant heat shields** are of several types, depending on the materials from which they are made.

Most materials, such as wood, asbestos board, black iron, gypsum, brick, etc., are good absorbers of radiant heat. They become hot themselves and, since a good absorber is

a good emitter, they re-radiate heat to the person they are designed to protect. If they have physical contact with the hot source they will attain relatively high temperatures and will radiate nearly as much heat as an unshielded source.

Absorptive shields, however, are useful if they are water-cooled. For example, an effective shield is one of sheet steel or iron mesh with water flowing down it. The metal absorbs the heat which is immediately carried away by the water.

Less expensive are reflective shields. Aluminum is the most satisfactory material. Thickness is unimportant, except for structural convenience. These shields will reflect 85 to 95 per cent of the heat striking them.

Their principles of operation, however, must be thoroughly understood. There must be an aluminum-to-air surface and preferably two aluminum-to-air surfaces, one on each side of the sheet. This means they cannot be imbedded between other materials. They should be painted or enameled. If covered with oil, grease or soot they lose their reflective property (although ordinary dry room dirt doesn't lower their reflectivity appreciably). If mounted on the wall of a furnace or oven they should be held out from the wall by brackets a couple of inches.

Their effectiveness is sometimes dramatic. Here, for example, are temperature readings taken at a square brick stack from a regenerative furnace. One side of the stack had mounted to it a panel of corrugated aluminum 2 in. away on brackets, covering the width of the stack, and extending from floor level upward about 7 ft. An adjoining side of the square stack was unshielded. Air temperature readings and globe thermometer readings were made about 8 in. out from the surfaces.

	Globe thermometer, F	Air temperature, F	Globe above air, F
Brick, unshielded	161	99	62
Aluminum shield	99	89	10
Reduction due to shielding	62	10	

The benefit of this shielding is apparent when it is realized that the globe thermometer is a far better indicator of what is "felt" than is the air temperature.

The globe may be thought of in this way: if the walls, floor and ceiling of the room—as "viewed" from one location—and the air and various objects in the room, are all at the same temperature, such a temperature would be the reading of a globe thermometer. Consequently, if every point in the room were at 161 F, obviously the room would be extremely hot. If the objects were not at the same temperature, the globe would indicate the average of the temperatures.

Assuming the room were 161 F, to reduce it 62 F merely by putting in place a 4 x 7-ft sheet of corrugated aluminum is a substantial achievement.

Notice that the elevation of the globe above the air temperature at the unshielded stack, 62 F, is the tipoff that the problem is essentially one of radiant heat. This is borne out by the fact that the air temperature before and after shielding dropped only 10 F.

While this drop in globe temperature of 62 F is clearly worthwhile the crux of the matter is this: such improvement could not be made unless the radiant heat were blocked off. No amount of ventilation, no amount of man-cooling wind, could have equalled or even approached the good that the reflective shield brought about!

A comment is needed here. When a man is completely wet with perspiration and his body is at normal temperature (as it must be if prostration is to be avoided), his perspiration can evaporate at varying rates, giving him a cooling effect, depending (a) on the velocity of air blowing on him, and (b) on the difference between the vapor pressure of water at his skin temperature (95 F in summer), P_s, and the vapor pressure of moisture in the air at the room-air dry- and wet-bulb readings, P_a.

To increase man-cooling air indefinitely is not a substitute for radiant heat shielding.

Vapor pressure of water in saturated air at 95F is 42.2 mm of mercury. Vapor pressure of water at room air temperature of 100F, or thereabouts would vary from 15 to 40 mm of mercury, depending on the humidity. A typical difference between P_s and P_a would be 20 mm mercury.

Haines and Hatch* show by chart the following maximum evaporative capacities for different velocities of man-cooling wind (at a 20 mm vapor pressure gradient.)

Air Velocity Ft/Min	Ratio	Max. Evap. Capacity BTU/Hr	Ratio
500	1.0	2050	1.0
1000	2.0	2650	1.3
1500	3.0	3100	1.5
2000	4.0	3425	1.7
3000	6.0	3980	1.9

Clearly there is a law of diminishing returns. Increasing the air velocity six-fold does not increase the maximum evaporative capacity even two-fold. Furthermore, physiological reactions limit the velocity of air that should be blown on a man. High velocity air becomes fatiguing to the individual; it may do more harm than good.

To increase man-cooling air indefinitely is not a substitute for radiant heat shielding.

Conclusion

The above does not imply that convective ventilation and man-cooling air are of secondary importance. Far from it: They should be provided in ample quantities, for they are just as necessary as control of *radiant* heat. However, when there *are* sources of radiant heat present, like furnace walls, ovens, red-hot metal, and the like, vastly improved comfort conditions will result if the radiant heat is attacked *directly*, by conductive insulation or reflective (or water-cooled) shielding. If radiant heat is the bulk of the worker's external heat load, comfort cannot be achieved, no matter *how* much ventilation is provided, unless the radiant heat is blocked off.

*Mellon Institute, Pittsburgh, Pa.

■ **Dust and fume concentrations** may be minimal or severe in the cleaning and finishing of castings. Health hazards, if any, vary widely depending on the nature of the operation and the size and chemical composition of the casting. A number of specific cleaning room operations require some form of ventilation.

■ **Sprueing station.** Sprues are removed from castings by (1) knock off; (2) cut off; and (3) burn off.

When sprues can be removed by tapping with a hammer, good practice suggests that dusty castings be tumbled or blasted prior to sprue knock-off.

Removal of sprues by oxyacetylene torch or carbon arc torch causes high atmospheric concentrations of fume which may be toxic. Hoods connected with flexible tubing have been used. They are effective if properly used but in practice they have not given a satisfactory solution to the problem.

■ **General ventilation** is rarely effective for torch cutting jobs since the workmen breathe the fume before it is exhausted by ventilators.

■ **Downdraft through floor grates** is limited in its application to burn-off operations for several reasons. For large castings, air velocity at the point of burning will be negligible if it is over 3 ft above the floor. In burn off, heat causes fume to rise against the pull of the exhaust system. In addition, large castings placed on a downdraft floor grate choke off suction, thus nullifying the effect of the system.

■ **An exhaust booth** with retractable or jack knife roof is effective for controlling fume from such operations without interfering with production. The roof is retracted or jack knifed by air cylinder or other mechanical means in order to admit the crane load. During burn-off the roof is closed, thus forcing incoming air to sweep fumes down and away from the operator's breathing zone. A suggested air volume found to be optimum is 150 cfm per sq ft of booth opening.

■ **Wet type tumbling mills.** These are one of several variations in tumbling mills and are especially adapted for cleaning non-ferrous products.

Tumbling mill is internally ventilated. High air velocities must be maintained in connecting pipes

CLEANING ROOM

Clean up the cleaning room by local exhaust ventilation.

The mill shells should be water tight and if a cover is used it should be close fitting and gasketed to prevent water leakage. In any method of wet tumbling the water level should be maintained to prevent the escape of any dust or dry dirt. In mills where there is a continual flow of water it may be recirculated if desired.

■ **Continuous type tumbling mills.** These vary considerably in design but all depend on removing all dust and dirt when it becomes fine enough. Not less than 400 fpm lineal velocity of air should flow into all mill openings.

■ **Batch type tumbling mills.** There are several types but all operate on the same general principle of periodic loading, operating and unloading.

1. Stave mills. These have staves or slats for the outside construction of the mill shell with the staves spaced sufficiently apart for the dust and dirt to drop through the openings. No regular means of exhausting stave mills is provided and they should be housed in an exhausted enclosure.

The air intake into the mill housing or enclosure should be located at the front and bottom of the enclosure and should be of such size that the average air velocity is at least 400 fpm.

2. Internally ventilated mills. In these all-metal mills the air for ventilating and removing the dust and dirt generated in the mill is drawn into one end of the mill and exhausted at the opposite end. A minimum velocity of 5000 fpm should be maintained in the branch

pipes connected to internally ventilated mills.

3. Duct ventilated mills. In these, the air for ventilating is drawn through two ducts diametrically opposed. The air flow is always constant regardless of how closely the mill is packed with products and there is little or no tendency for the dust and dirt to drop out of the tramp-iron trap. A minimum velocity of 5000 fpm should be maintained in the ducts and branch pipes connected to duct-ventilated mills.

■ **Abrasive cleaning.** Various types of equipment and different methods of projecting a variety of abrasives are used in blasting metal parts. Much dust is created and all types of equipment and auxiliary parts must be substantially built. They must be constructed so there is no outward leakage of dust into the general atmosphere when the exhaust system is operating. Among the types of abrasive blasting equipment are:

1. Abrasive blasting rooms. Where the operator is working within the room the abrasive blasting room should have down-draft ventilation or not less than an average of 80 fpm velocity over the entire projected floor area.

2. Abrasive blasting tunnels. In these the product to be cleaned passes into the cleaning room or chamber through an entrance opening by some means of conveyance and then passes out of the room through an exit opening. Entrance and exit openings should be provided with vestibules of sufficient length or number of turns so that the baffling over the cross-sectional area of the vestibule openings, provided to prevent ricocheting of abrasives, will be effective.

An average air velocity of at least 300 fpm into the vestibules through the net open area of the doors or curtains is recommended. The abrasive blasting portion of the tunnel should be provided with downdraft ventilation of not less than 80 fpm average velocity over the entire projected floor area.

3. Rotary abrasive blasting tables. In this equipment the product is loaded onto a horizontal rotating table and passes into an enclosed chamber for abrasive cleaning. The volume of air exhausted from the chamber should be not less than equal to 200 cfm per sq ft of gross area of the inlet and outlet openings without the protective curtains in place.

4. Abrasive blasting mills. Whether of the barrel or conveyor type (airless), they should be ventilated at least equivalent to 20 air changes per minute, based on the empty cubical contents of the work chamber.

5. Abrasive blasting hand cabinets. These are small enclosures in which the parts are cleaned either by manipulating the product or by abrasive stream directed by the operator who views the operation through a plate glass window from the outside.

In no event should the average velocity of air entering all openings in the cabinet be less than 500 fpm.

6. Hydraulic blasting or cleaning units. Units using water to clean with or without abrasives should be confined within enclosures that will prevent the water and/or abrasives from splashing or ricocheting outside the enclosure.

■ **Grinders.** Grinders should use the air volumes recommended and the exhaust should be increased when poisonous metals are processed. Four types of grinders are referred to here.

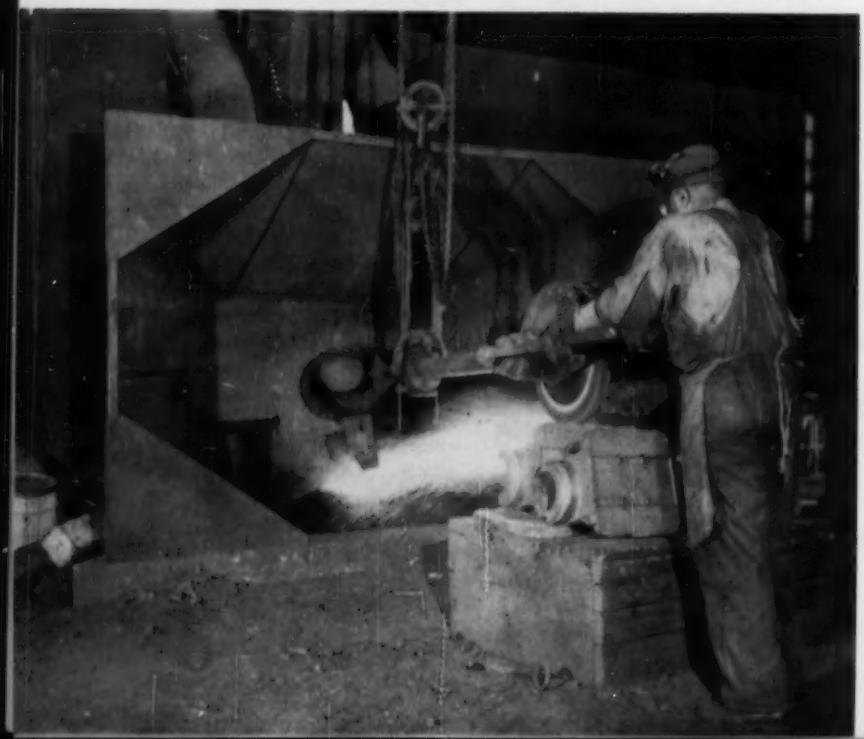
1. Spindle grinders. Hoods should be carefully designed and it should be noted that exhaust volumes vary with wheel diameter.

2. Portable grinders. When castings are light enough to be handled on a bench, a bench grinding booth gives adequate protection provided exhaust air volumes are of the order of 150 cfm per sq ft of booth face opening.

3. Swing frame grinders. Dust is most effectively controlled by an exhaust enclosure. A control air volume of 100 cfm per sq ft of opening is a minimum and 150 cfm/sq ft of opening is preferred.

4. Stiff shaft grinders. Dust from stiff shaft grinders is best controlled by an exhaust booth. Booths must be designed to give a minimum air velocity of 100 fpm at the grinding wheel.

Exhaust hood is used for swing frame grinder but an enclosure would control dust more effectively. Some kind of local exhaust is required.



■ Dusts, fumes and gases generated by welding may produce adverse effects on health. Special precautions should be taken when the following materials are involved in a welding process.

- Fluxes containing fluorides.
- Fluoride coated welding rods.
- Beryllium alloys.
- Zinc.
- Brass or bronze containing lead.
- Copper containing lead.
- Metals coated with lead paint.
- Silica burned into castings.
- Cadmium coated materials.

■ **Local ventilation.**

1. Booths and hoods should be provided to capture at the point of generation dusts, fumes and gases given off in the operations listed in (2) below when any of the following conditions exist:

- The operations are considered production jobs.
- The operations are performed in a repetitive manner.
- The work can be adapted to a booth or hood application.

2. Operations requiring ventilated booths and hoods.

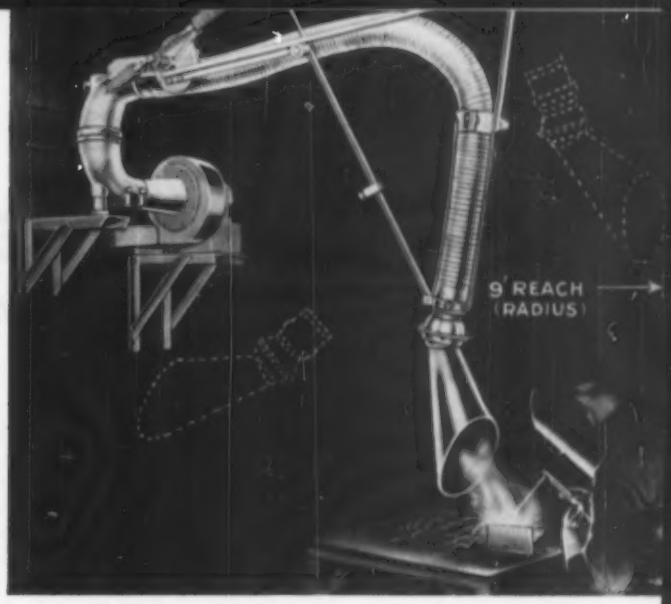
The following operations should be provided with ventilated booths or hoods.

- Gas and arc welding operations, if any of the material, coatings, welding rod or filler material contain toxic substances.
- All arc welding operations.
- Metallizing operations.
- Brazing operations.
- Babbitting operations.

3. Design of booths and hoods.

Due to the many operating conditions encountered, a thorough study of the specific operations to be controlled should be made and the fundamental principles of hood design, together with the general principles listed below, should be applied:

- Enclosed booth. If an enclosed booth is used in connection with an operation requiring ventilation, the position of the work and the welder should be such that dusts, fumes and gases are drawn away from the breathing zone by the exhaust system of the booth.
- Stationary exhaust hood. Operations lending themselves to exhaust ventilation by means of hoods should have the hoods located as close to the work or equipment as practical.



Hoods should capture fume at point of generation.

WELDING . . . WOODWORKING

Two local exhaust problems.

- Movable exhaust hoods. Where the size of the parts being welded or the location and positioning of the points of operation do not lend themselves to stationary booth and hood application, easily positioned and movable exhaust hoods may be used to capture the dusts, fumes and gases generated.
- Minimum amount of exhaust air required. Any booth or hood should be connected with an exhaust system of a capacity sufficient to produce a minimum air flow of 100 fpm at the point of generation of dusts, fumes and gases.
- **Woodworking machines** are often the source of fire hazards; thus local exhaust ventilation is sometimes necessary in order to remove sawdust and wood shavings from floors and machines.

Exhaust hoods should be adapted to the type of machine they ventilate and be installed at the point of operation. A hood should never interfere with the operation of the machine or obstruct the operator's vision of the cutting tool or tool guard.

Hoods for any kind of woodworking machines can be designed by use of the engineering principles explained on page 52 and following pages.

Duct velocities of approximately 4000 fpm are recommended in order to insure satisfactory conveying of sawdust, shavings and chips and to meet requirements of most state codes.

- **Duct design.** The exhaust system for pattern shops may be designed according to methods explained. The system should be separate from any other collection system in the foundry.
- **Fire and explosion hazards.** When pattern shops are isolated from the rest of the foundry by fire walls, exhaust ducts should not extend through fire walls unless it is absolutely necessary and in such cases fusible link pipe shutters should be placed on each side of the fire wall.
- **Solvents and lacquers.** Solvents and lacquers are often used in pattern shops. To determine the need for or kind of ventilation, it is necessary to know not only the degree of toxicity or flammability of the solvent or lacquer but also the atmospheric concentration reached.

Control of vapors may be accomplished by dilution ventilation or by local exhaust. If patterns are sprayed with lacquers, exhausted spray booths are effective for removing solvent vapors.

DUST and FUME COLLECTION

There's a collector for every problem.

■ **Dust problems** in foundries have become more complex because of accelerated production, new methods and materials. Foundry dusts range from those which are hazardous down to those which are just plain nuisances.

Three of the most common type of collectors are centrifugal, cloth-type and wet type. Electrostatic precipitators, a fourth type, have special applications.

■ **Centrifugal dust collectors** use radial acceleration of the air stream for separating solid particles from the main air flow into a quiescent zone. The dust then settles out by gravity into a receiving hopper.

The trap type is the simplest centrifugal collector, but it is ineffective except on large particles. The so-called common cyclone type is next in order of efficiency but it too has a rather low separating force, as has also the volute or spiral type collector. Of the various types, the high efficiency cyclone is the most effective.

Complete collection of the very small particle sizes of the order of five microns usually is not feasible in a centrifugal collector. The exhaust air, therefore, should be exhausted outside the building.

■ **Cloth-type dust collectors** remove dust from the air stream by flowing the air through specially designed filter fabric. Two general designs are available—the tube or bag type and the screen type. Mechanical members which support the cloth envelopes are connected to a rapping device for dislodging the dust pack from the cloth surface. Hoppers are provided below the screens into which the collected dust is deposited.

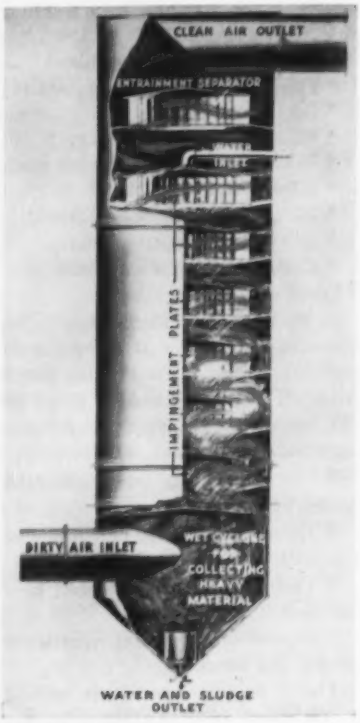
■ **Wet-type dust collectors** entrap dust particles in a liquid, usually water, and convey it by the liquid to a settling tank or disposal area. They have a high efficiency in foundry operations.

The method of entrapping the dust particles varies with the design of the collector. The collector water patterns are obtained by using a fresh water supply, recirculating pump, rotor, or the air stream itself.

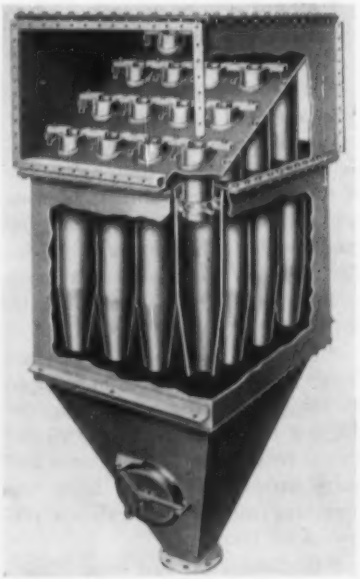
The types of wet collectors are (1) spray or water curtain type; (2) dynamic precipitator type; (3) impingement type; and (4) combination of these types.

Wet-type collectors have no fire hazard, no health hazard from handling dust. They eliminate fluctuations in air volume and can operate continuously.

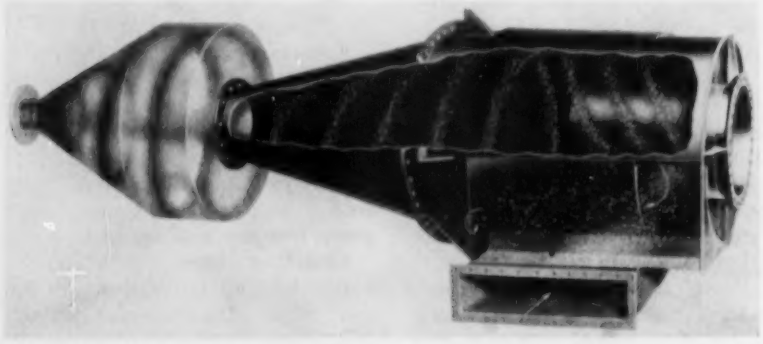
See also "Do's and Don'ts of Fan Connections" by William E. Tracy, in AMERICAN FOUNDRYMAN, *June, 1955.*



Wet-type collectors work well, are highly efficient in foundries. They eliminate fire hazards and other problems of handling dust.



Felt tube collector is version of successful cloth-type designs. Hopper beneath the tubes can be opened to remove collected dust.



Cyclone collectors (they usually stand upright) separate large dust particles but none completely collect the critical (5 micron) sizes.

MAINTENANCE and TESTING

Simple principles of preventive maintenance will keep your system humming.

■ An adequate scheduled maintenance program for foundry ventilation and dust collecting system will pay for itself by reducing production time losses and costly major repairs.

Effective maintenance of ventilation and dust collecting systems is more easily accomplished if two rules are followed:

- Provide for the convenient installation, cleaning, and removal, of any part of the system.
- Establish a routine procedure for inspection and care of all existing ventilation and dust collecting systems.

■ **Provision for convenient maintenance** begins on the drawing board. The designer and the installation craftsmen should allow for the eventual removal of parts which may wear out or be damaged by other equipment.

Extra heavy construction should be used for those parts normally exposed to the greatest wear or mechanical abuse. Adequate service catwalks, platforms and ladders should be installed to provide for worker safety, convenient equipment access and maintenance.

A data file should be made up for each ventilation or dust collecting system. This file should include:

1. Actual operating data such as fan speed, motor load in amperes, air inlet and outlet velocities and volumes, suction, pressure readings at various points in the system, dates readings were made and reason for not making readings.
2. Complete name plate data and detailer ordering descriptions of all equipment.
3. Parts lists and spare parts reference drawings, including commercial description of such things as bearings, belts, sprockets, and sheaves.
4. Copies of all construction drawings and sketches.
5. A complete index of all information in the book.

■ **Exhaust hoods.** Foundry exhaust hoods should be built to withstand vibration, impact, erosion, and corrosion. Hood panels should be constructed of not less than 16 gage metal. Hoods should be reinforced to prevent impact damage.

Crane serviced shakeout hoods should be built of ¼-in. plate with bumper rails to protect the hood inlet. Entrance slots of sheet-metal hoods will not stand up under impact but 3-in. pipes or steel plates properly welded into a substantial structural steel frame should give good results.

■ **Ductwork.** All ducts should be constructed with flanged joints for easy installation and replacement. Various parts of a system subject to abrasive wear can be equipped with removable wear sections. Long runs of round duct can be rotated a part turn several times to obtain maximum life in service. Welded rather than riveted construction should be used for ducts handling abrasive dust.

All duct systems should be provided with an adequate number of inspection and cleanout openings. In general, a cleanout door should be provided when there is:

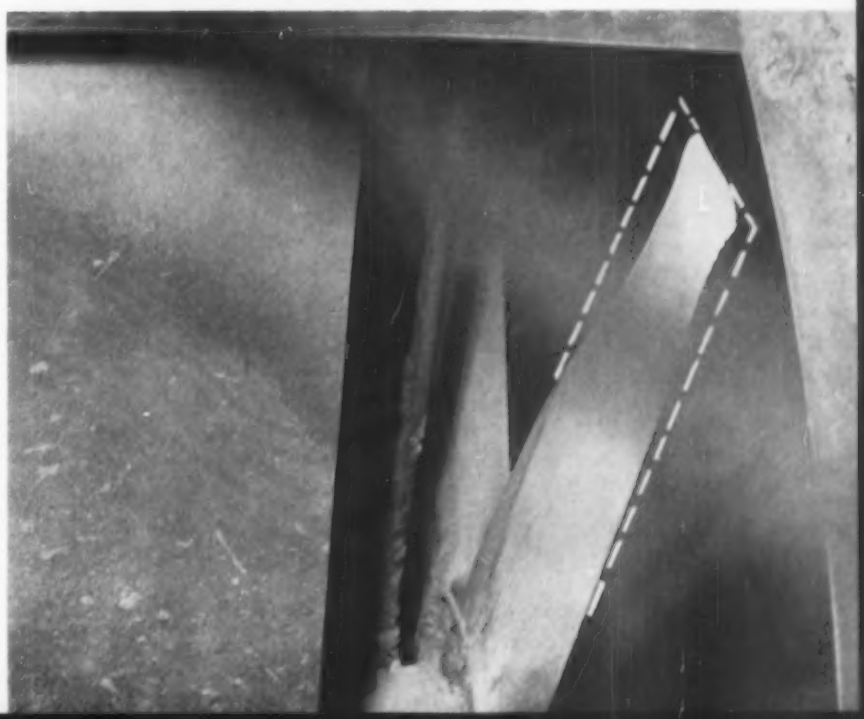
1. An abrupt change in direction of the pipe.
2. An expansion in the line.
3. Any fitting or attachment causing a sudden drop in air velocity.

Ducts subject to mild corrosion should be coated with asphaltic, plastic, or rubber-base paints.

■ **Fans.** Most fan troubles result from three basic causes:

1. Accumulation of dirt on fan impeller or fan housings.

Even heavy duty fans abrade and must be inspected regularly in foundry operations. Dotted line represents original shape of blade.



2. Abrasive cutting of fan impeller or fan housings.

3. Indifferent care of fan drive and bearings.

While vibration may also seem to be a primary cause of fan failure, vibration itself is usually the result of one of the above causes.

In preventive maintenance, first study the source of any materials which may build up on or abrade fan surfaces to determine whether any changes can be made in the exhaust system to reduce the amount of material carried through the fan. Next, consider the type of fan which is causing trouble. Centrifugal fans with multi-blade squirrel-cage impellers are not suitable for foundry exhaust systems. Coatings of dirt will not remain uniform on all blades and the fans will soon vibrate. Such fans should be replaced by wide blade backward-inclined or radial-blade centrifugal fans.

Heavy duty industrial fans should be used because of the more rugged construction of the housing, impeller, shaft and bearings. Propeller fans should be of the cast airfoil blade type.

All centrifugal fans should be inspected regularly for the effects of abrasive wear or corrosion.

On systems with dust collectors, the fan should be installed on the outlet side of the collector for the best fan life.

The V-belts on all fan drives should be kept tight and all motors should have take-up bases. When a belt in a multiple belt drive breaks all the belts in the drive should be changed at the earliest fan shutdown period.

Foundry fans should be equipped with ball or roller-bearing units which are lubricated with heavy-duty grease and have good grease seals. On centrifugal fans one bearing unit should be of the floating type. Grease leads should be provided in order that bearings may be lubricated outside a duct. All grease fittings should either be removed for each lubrication and an alemite-type fitting inserted.

Bearings for roof ventilators should be of the double-shielded, cartridge type. These require no regular maintenance and are easily replaced.

Fractional horsepower motors and propeller fan motors located in the air stream should be of the totally enclosed non-ventilated type. Totally enclosed fan-cooled motors have small annular spaces through which cooling air must pass. These spaces tend to fill with dirt and are difficult to clean.

■ **Dust collectors.** Five basic types of collectors are used in foundries today. In selecting the proper one consideration should be given to the degree of removal required by plant location, etc., quantity and characteristics of contaminant to be removed, and condition of the air stream.

There are three general rules for the proper maintenance of all dust collectors:

1. A regular schedule for removing the collected material from the dust collector hoppers.

2. Inspection of all parts of the dust collector at definite intervals.

3. Cleaning or repair of the dust collector when the regular inspection indicates the need.

■ **Simple cyclone and multiple cyclone collectors.** Multiple cyclones are more efficient than simple cyclones and have the same application. They should have outlet tubes tightly sealed into the header sheet to prevent dust from by-passing the cyclones. The type of multiple cyclone in which short multivaned swirl rings impart the whirling motion to the air stream should be protected against paper, rags, or wood scraps by using ¾-in. mesh round-wire screens at the duct inlets in a visible place.

The dust storage hoppers for all types of cyclones must be emptied regularly.

■ **Fabric dust collectors.** Items which should be checked in a routine inspection of fabric type collectors are:

1. Fabric envelopes or tubes for dust leakage or for holes in the fabric.

2. Complete rapping mechanism including the individual rapping hooks or cranks.

3. Dust blow-back mechanism for fabric cleaning.

4. Baffle plates for unusual wear or holes.

5. Spark screens for plugging or wear.

6. Hoppers for undue wear or dirt build-up.

7. Hopper valves for leakage or defective operation.

8. Fan as described under fan maintenance.

The pressure drop through a cloth collector just before the shakedown cycle should not exceed the design pressure drop. If the pressure differential is excessive it is due to one or more of the following:

1. The collector is over-loaded.

2. The cloth pores are plugged by moist or sticky materials.

3. The shaker mechanism is defective.

■ **High efficiency dry type collectors.** High efficiency dry dust collectors combine the dust separator and fan into a single unit. Good maintenance dictates the following:

1. Emptying the dust storage hopper regularly.

2. Making certain the dust storage hopper is vented back to the collector.

3. Inspection of the impeller and wear liners at 6-month intervals.

■ **Wet type dust collectors.** All collector surfaces in contact with water or moist air can be treated with a high quality water resistant, and rust retarding coating. Sheet rubber can be applied to areas subject to severe abrasion. Since crust tends to form slowly on the internal surfaces of wet collectors, these surfaces should be carefully cleaned and the protective coatings renewed as required.

The wet cyclone collectors must be supplied with an adequate flow of clean water.

The fan of a wet cyclone collector should not be run unless water is flowing through the collector.

■ **Wet rotary centrifugal collector.** The wet rotary centrifugal collector is similar to the dry type except that the wet collector has a wet pre-

cleaner and a water spray at the impeller inlet.

The drain pipe connected to the air outlet should be periodically inspected for plugging.

■ **Turbulent water bath collectors.** Turbulent water bath collectors are equipped with baffles to force the air to travel through the water bath. These baffles and the moisture eliminator plates should be regularly checked for accumulation of encrusted dirt.

The water overflow pipe must always be kept open to prevent a high water level which will reduce the air capacity of the collector. The water level regulation devices should be kept in good condition to prevent a low water level.

■ **Sludge-settling tanks.** Proper operation of sludge-settling tanks is essential. The maintenance man should not let the settling chamber of the dewatering tanks fill completely with sludge.

Settling tanks with drag chain sludge conveyors are built as separate assemblies or as integral parts of dust collectors. These conveyors should be equipped with an automatic timer which will run the conveyor for a sufficient period of time after the fan is turned off in order to remove sludge.

■ **Testing exhaust systems.** Air flow measurements of an exhaust system are necessary for the following reasons:

1. To determine whether an exhaust system is functioning according to design.
2. For setting blast gates on systems designed for blast gate balancing.
3. To determine if the exhaust requirements of regulatory authority have been met.
4. To obtain design information from satisfactorily controlled operations for future control of similar operations.
5. To determine if maintenance or repairs of a system are necessary in order to restore efficient operation.

The measurement of air volume usually is the most important phase of testing an exhaust system. Since most field meters measure air velocity rather than air volume, the air velocity in a hood or duct must not only be averaged but the cross-sectional area of the hood or duct must also be measured in order to determine the air volume.

■ **Testing instruments.** The general types of instruments for measuring air flow are divided into two groups, as follows:

Group 1—Instruments for Measuring Air Pressures in Pipes

1. Pitot tube
   - A. Manometer gages
     - I. Vertical gages
     - II. Inclined gages
       - a. Single tube with reservoir for fluid.
       - b. Double tube.
   - B. Magnetic gage
2. Thermo-anemometer

Group 2—Instruments for Measuring Air Flow Into Hoods and Enclosures

1. Swinging-vane direct-reading velocity meter
2. Thermo-anemometer
3. Revolving vane anemometers

■ **Testing by pitot tube and gages.** The volume of air (cfm) flowing in a pipe or duct should be determined by measuring preferably the mean traversed velocity pressure or the center pipe velocity pressure in inches of water with a pitot tube and manometer gage.

In practice, the pitot tube is connected to a manometer gage or to a magnetic gage. The impact end of

Electrostatic dust sampler measures dust going through system. It determines dust volume and degree of dust-freeness of cleaned air.

the tube should be pointed against the flow of air and parallel with the pipe. A drilled hole as small as possible should be made in the duct for the insertion of the pitot tube, and such hole should not be less than 10 pipe diameters down-stream from any elbow or change of pipe section, or as near this location as the pipe installation will permit.

If an inclined tube manometer gage is used it is essential to level the gage carefully to obtain an accurate velocity pressure measurement.

When a vertical tube manometer gage is used the gage should be held in a vertical position.

The fluid level in both the inclined and vertical manometer tube gages should be adjusted and set at zero before making the test.

It is essential that exactly the same fluid be used in the manometer tube for which the scale of the tube was designed.

To obtain a velocity pressure reading the tube terminals of the pitot tube are connected by tubing with air-tight connections to both legs of the manometer gage.

The reading indicated by the fluid level differential on the manometer tube scale, corrected if necessary to water-gage equivalent, is termed the velocity pressure in inches of water.

The pitot tube must be inspected frequently to make sure that the small static orifices are not plugged and that the walls are not bent or dented.

Rubber tubing connected to the instrument must not be constricted or pinched.

■ **Testing by swinging vane type direct reading velocity meters.** The swinging vane type direct reading velocity meter may be used for obtaining the air velocity at the face openings of hoods and enclosures.

For large openings the meter may be placed directly in the air stream for velocity determinations without any appreciable error. However, for small openings the standard calibrated jets attached by a standard calibrated length of tubing should be used to eliminate the obstruction to air flow caused by the body of the meter.

■ **Testing by thermo-anemometer.** The thermocouple of the instrument is inserted in a test hole of the ventilating pipe and held in the center of the air stream. A direct measurement of the air velocity is then obtained from the meter scale.

The thermo-anemometer may also be used to measure velocities into exhaust hoods and enclosures by placing the thermocouple of the instrument directly in the air stream.

■ **Testing by revolving vane type anemometer.** If revolving vane type anemometers are used for determining the air velocity at the face of the hoods and enclosures they should be carefully calibrated for the expected velocity range.

■ **Routine testing.** One or more of the appropriate instruments previously described should be used for the initial adjustment of an exhaust installation. Later, routine checks of system performance can be made with the simple U-tube after drilling (never punching!) 1/16-in. holes in ducts connected to:

1. Inlet and outlet of dust collectors.
2. Inlet and outlet of fans.
3. Exhaust hoods.
4. Sections of the system upstream of dampers.

Static pressure readings should be taken with the U-tube at each test hole and recorded as soon as the system is properly adjusted.

If to prevent freezing, a liquid (e.g., kerosene) with a specific gravity other than that of water is used, the readings should be corrected by the following formula:

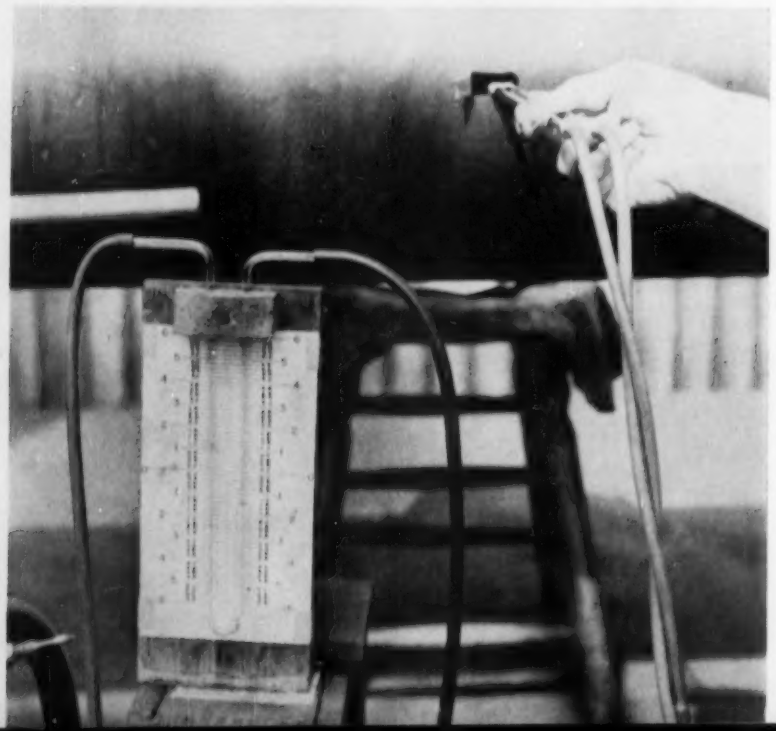
$$R_c = R_a \times \text{Sp. G.}$$

Where: R_c = corrected reading.
R_a = actual reading shown onale.
Sp. G. = specific gravity of liquid used.

Example: If kerosene, which has a specific gravity of 0.82, is used as the liquid, and the scale shows a 5-in. differential between the liquid levels of the tubes — to equate the reading to inches of water, substitute the values in the equation, thus:

$$R_c = 5 \times 0.82$$
$$= 4.1 \text{ in w.g.}$$

Pitot tube measurement can determine velocity of air going through pipe and simple calculations convert velocities into volume figures.



■ GOOD HOUSEKEEPING is a basic element in any program of dust control and is an important factor in reducing the incidence of occupational disease and especially of accidents.

Poor housekeeping is evidence of only limited concern over the working environment. Under such conditions full use of important dust control measures will not be realized.

Painting the inside of a foundry and routine washing of windows do not in themselves reduce dustiness but they change the attitude of management and workmen alike toward working conditions.

Good housekeeping is especially important where castings containing toxic materials such as lead and beryllium are being made. Lead poisoning especially has been much reduced by improving housekeeping.

A study of 43 foundries in New York state revealed that cases of silicosis in those plants were in inverse proportion to the degree of housekeeping. The better kept the plants, the fewer cases of silicosis.

Accumulations of overhead dust finally reach the angle of repose and dust from superstructures and floors is constantly made airborne by building vibration. Particles of physiologically significant size (below 5 microns) will remain suspended in still air for extremely long periods.

Published tables give rates of settling in still air for spherical particles of different sizes. According to Stokes' law, a spherical particle having the same density as quartz and 100 microns in diameter will fall in still air at the rate of 160 fpm. A 50 micron particle will fall at 40 fpm; a 10 micron particle at 1.8 fpm, and a particle 1 micron in diameter at 0.016 fpm or 1 ft per hr. The most dangerous dusts are the ones that settle last.

Vacuum cleaning of the foundry equipment and structures is a preferred method of removing settled dust. Compressed air methods merely move but do not remove dust.

Accumulation of discarded materials takes up valuable floor space and makes the cleaning job more difficult. In many cases disposal or proper storage of seldom-used patterns or flasks will more than pay for itself in increased floor space and in greater ease of clean up.

Vacuum cleaning saves light, encourages workers to keep foundry neat.

HOUSEKEEPING

A place for everything and everything in its place.

Dirty reflectors on luminaires can reduce the illumination level by as much as 20 per cent. Walls darkened by dust absorb additional light so that the average illumination intensity is greatly diminished.

Broken windows in the roof monitor cause an air short circuit to roof ventilators, thus neutralizing their efficiency at floor level. Broken windows at working levels allow cross air currents which may interfere with the proper flow of air to hoods.

In order to provide reasonable protection for the health and safety of employees, the following rules of housekeeping are minimum:

■ **Storage.** All products, supplies, materials and equipment parts should be stored efficiently in places provided for them.

■ **Accumulation of refuse.** Accumulation of refuse and by-products should not be allowed to develop to the extent where they would affect the health or safety of workers.

■ **Safe disposal of refuse.** Combustible or explosive refuse should be disposed of at least daily in order to eliminate exposures to fire, accident and health hazards.

■ **Condition of floors.** All floors, aisles, gangways and passageways should be kept in good repair and free of obstructions in order to prevent accidents.

■ **Care of floors.** Floors should be maintained in a clean condition, preferably by use of vacuum cleaners. Dry sweeping should not be permitted. Where wet processes regularly cause wet floors, drains, false floors, platforms, mats or other dry standing places should be provided.

■ **Care of buildings and equipment.** Structural parts of buildings, equipment, and fixtures should be kept sufficiently free from accumulations of dust and dirt so that natural air currents and vibrations in the buildings do not release dust into the breathing zone.

■ **Eating in work rooms.** Employees engaged in any process where toxic materials can be taken into the human system by mouth should not be allowed to lunch on the job.

Employees handling toxic materials such as lead in any form should be required to wash before eating and proper eating facilities should be provided.

▪ **Smoking.** Employees should not be permitted to smoke in pattern vaults, nor around woodworking, painting and magnesium casting cleaning operations. Employees whose work clothing is contaminated with magnesium dust should not be permitted to smoke or approach open flames and others who are smoking.

Dusty Operations

Dust control by isolation is based on the theory that in lieu of other control methods only a minimum number of employees will be exposed to a dust producing operation. In most foundries only a small percentage of total employees will thereby be exposed.

Isolation may be in space or in time.

▪ **Isolation in space.** Where practical, dust producing operations should be performed in separate buildings or departments or completely enclosed within a department. In some instances it may be more feasible to isolate the non-dusty rather than the dusty operation. For example, it may be desirable to isolate the coreroom, which is not inherently dusty, from dust producing operations.

▪ **Isolation in time.** Dust producing operations may be delayed to the night shift or performed at times when a minimum number of workers is exposed. For example, shakeout may be limited to the night shift when only a small crew is on duty. Or dust collectors may be emptied during the lunch period.

Dust control by isolation is especially applicable to small foundries but it should be considered only as an interim remedy until it is feasible to install proper protective equipment.

▪ **Substitution of less toxic materials.** All dusts are not equally hazardous. If it is practical to use a less toxic material it is good practice to do so. Thus zirconite may be substituted for silica flour, non-siliceous parting compounds for siliceous types. The substitution of steel grit or shot for sand in abrasive blasting operations has been successful. Chlorinated hydrocarbons can often be replaced with less toxic solvents.

▪ **Wetting agents.** The application of water is probably the oldest method of dust control. In the foundry it has been used principally for sprinkling floors, gangways and aisles to prevent dust dispersion. Water, however, does not wet small dust particles readily nor does it rapidly penetrate a porous mold. In other words, ordinary water is not "wet" enough for many industrial applications. Wetting agents have now been developed which even in small amounts produce a reduction in the surface tension of water, enabling it to wet dust particles more readily.

Wetting agents developed for specific uses are commercially available in concentrated form or as a solid (cartridge type) and require dilution before use. Automatic proportioning equipment is available. Usually one gallon of concentrate will treat 1000 gallons of water. Wet water is commonly applied by spraying through one or more nozzles at pressures from 75 to 125 psi.

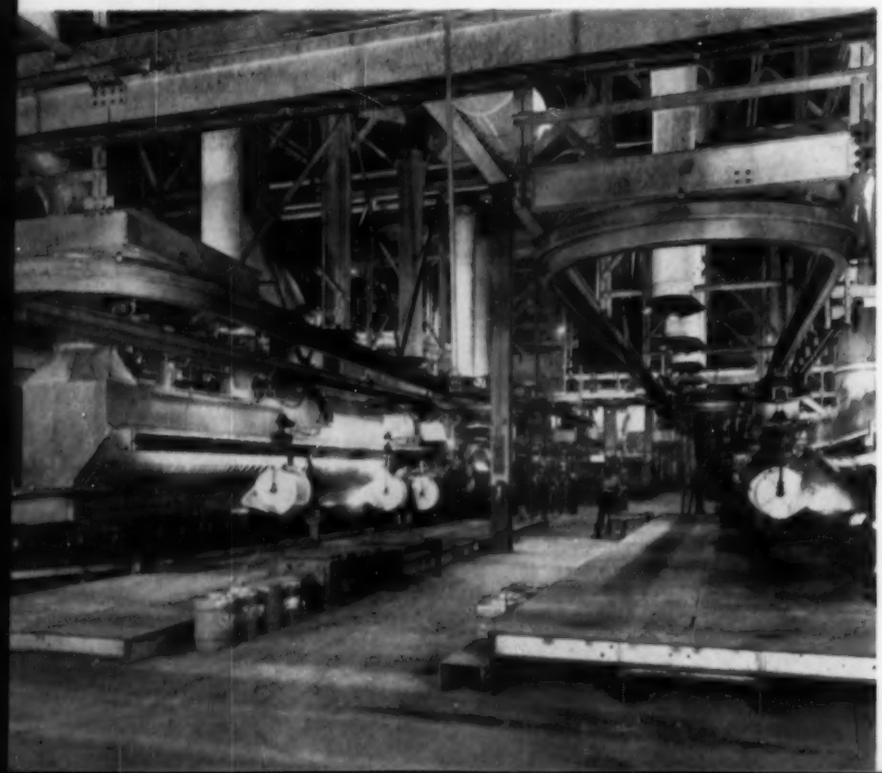
Wet water spreads rapidly, penetrates sand heaps readily and wets individual dust particles. It may be employed in three different ways to control dust in the foundry:

1. To prevent dispersion of dust accumulations on floors.
2. To suppress dust at the point of origin.
3. To remove dust from the air after it has escaped from its source.

Walking over floors newly sprayed with wet water will not disturb the top surface and expose the dry dust underneath.

In suppressing dust at the point of origin, wet water has been found useful to control dust from sand conditioning machines by means of flat spray nozzles. Wet water fogs may be used to allay dust rising from shakeouts.

A clean orderly foundry implies efficiency, good in-plant environmental conditions. All work together for more profitable operation.



Automation Explained

A 16-page booklet of automation, *"The Adventures of Ripp Vann Twinkle,"* explains in easy-to-understand words and pictures that automation is nothing new. It merely means increased industrial productivity, and has been around and in use in some form for centuries. The booklet helps an employee see the importance of automation to his company in keeping up with and ahead of competition, to insure his job and the future of his company.

The modern Ripp, like his famed predecessor, falls asleep just after reading some hair-raising news about automatic factories taking over production. Ripp's dreams go back as far as the Egyptian water carriers, who were convinced that unemployment would result when pipes were laid to bring water to the city. Gazing back through the centuries with Ripp from then on is an interesting and informative experience. For more information, sample copy and quantity prices, contact Enterprise Publications, 11 N. Wacker Drive, Chicago.

Release Die Casting Film

"Die Casting—How Else Would You Make It?" is a new 16-mm color-sound motion picture released recently by the American Zinc Institute. The film, which has a running time of 35 min, tells how designers are able to effect reduction in costs and shape a better product by taking full advantage of an important production method.

The film pictorially describes the die casting process and depicts its versatility and scope by showing the range of shapes and sizes possible. It illustrates the widespread use of die castings in the home, the world of commerce, industry, transportation, and every walk of life. Advantages and limitations of other ways of working metal are reviewed.

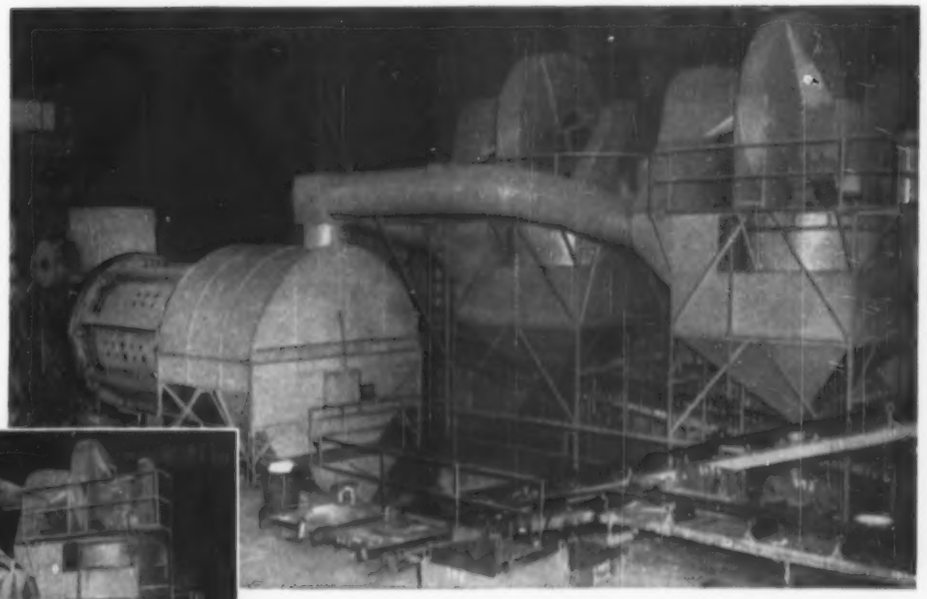
A comprehensive discussion and evaluation of die casting alloys—zinc, aluminum, magnesium, and copper base—are included, pointing up the merit of each.

A 24-page booklet entitled *"Die Casting"* will also be available to audiences containing supplementary technical information. For further information concerning the film write to American Zinc Institute, Inc., 60 East 42nd St., New York 17, N. Y.

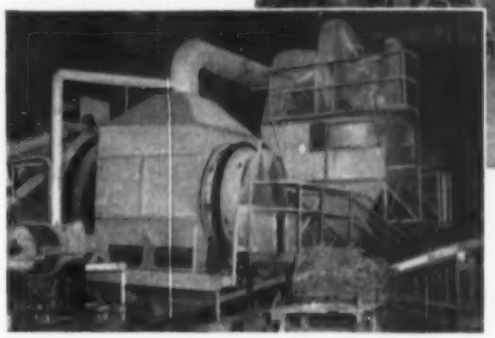
ROTO-CLONES "WRAP UP"

1½ TONS of DUST per HOUR!

43 lbs. of dust per minute is exhausted from core breaker by Type W ROTO-CLONE.



10 lbs. of dust per minute is collected from this sand screen by Type W ROTO-CLONE.



Over 50 lbs. of dust per minute collected from foundry core breaker and sand screen

THIS large steel foundry handles 150 tons of sand per hour. Two of the worst offenders from the standpoint of dust were the core breaker and sand screen—until the problem was assigned to ROTO-CLONE.

Illustrated at upper right is the core breaker which is exhausted by a Type W ROTO-CLONE of 60,000 cfm capacity. Every minute this unit is in operation results in the collection of 43 lbs. of dust. The 6 ft. diameter sand screen, pictured at lower left, is also served by a Type W ROTO-CLONE of 14,000 cfm capacity, which collects 10 lbs. of dust per minute. Both collectors are equipped with built-in Precleaner which removes the bulk of dust from the exhaust air by centrifugal force.

50 lbs. per minute, 1½ tons per hour! How's that for processing heavy dust concentrations of abrasive sand? Such efficiency results from the Type W's design which combines the scrubbing effect of water sprays with the principle of dynamic precipitation. What's more, there's no secondary dust problem as collected material is discharged as a slurry.

These are but two of scores of tough dust collection jobs which AAF Dust Control Equipment is handling as "run-of-the-mill" operations. For complete product information call you local AAF representative or write direct.

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SMOOTH THAT ALLIGATOR SKIN!

Researchers Found That a Little Bit of Sand Additive is Good— But Too Much is Too Much

BURDETTE JONES/*Sand Lab Foreman*
John Deere Waterloo Tractor Works, Waterloo, Iowa

■ Casting finish is becoming increasingly important. New processes such as shell molding, D process, and investment casting have been developed with one of their features being good finish.

Over the years, various means have been used to improve the surface finish of green sand castings. Today a variety of additives is being used in molding sands in an attempt to minimize cleaning costs, eliminate or reduce machining operations, or improve appearance. The trend in sand seems to be toward finer sands with a specified number of screens.

Several years ago, a series of test castings was made using sands from the various molding units in the plant. Some production sands produced expansion defects on the test casting though they could produce a satisfactory finish on the size and weight of jobs on the molding units in which they were used. A test pattern 12 in. square and varying from ⅜ to 2 in. thick was used. The pattern was made of plywood and the thickness was increased by adding more pieces of wood. Castings were made to compare the molding sand mixes, pouring times, and iron temperatures.

During the investigation to reduce expansion defects, various kinds and amounts of carbonaceous materials were mulled into the sands. It was noted that as the carbonaceous materials were increased, effects of expansion were eliminated. However, with excessive additions of these materials, the castings became dirtier. To go to extremes, a test casting was faced with a pre-mix, containing no sand at all, as described in the May 1954 issue of AMERICAN FOUNDRYMAN (pages 123-126). This mix was composed of 1½ parts by weight of a hardwood wood flour, 4 parts by weight of sea coal, 3 parts of western bentonite, with enough water (about 14 per cent) so that it could be used as a molding material.

The casting appeared to be covered with a raised honeycomb of very highly veined iron. This peculiar surface condition was thought, at that time, to be over-correction of expansion, an example of excessive contraction. The experiments were stopped before the cause of this condition was determined.

Later, another series of test castings was made. The purpose of this investigation was more basic — to start determining the effects of sand additives individually on gray iron. Materials such as western bentonite, sea coal, wood flour, pitch, and cereal are used in most foundries. A series of test castings was made in which increasing amounts of these and some additional ones—rosin, urea formaldehyde, and coke—were added to a base mix. To be conclusive, each was added in extreme amounts.

The base mix was a washed and dried, four screen, 68 to 72 AFS fineness number silica sand with 5 per cent western bentonite added for bond. The various percentages of materials were added to this base, mulled dry in an 18-in. laboratory muller 3 minutes, then an additional 4 minutes with sufficient water to temper.

Two test patterns, 8 in. square and ½ in. thick were mounted on the drag side of a matchplate for a 12 x 22-in. snap flask. Two gates, ¼ in. thick and ¾ in. wide connected one side of each pattern to a common runner. The cope was a flatback except for the runner. Two test castings in the same mold allowed a beter comparison of molding materials by practically eliminating all of the mechanical varia-

tions of molding, pouring time, ferrostatic pressure, and metal analysis or temperatures.

After several castings were made with this new pattern, it was decided that more information would be gained if the prepared mix was also compared at the same time with some regular production molding sand. So, a strip across the center section of both cope and drag, parallel to the runner was faced with the material being tested. The rest of the pattern, gates, and runners were covered with squeezer heap sand.

Western bentonite was used to start the series. The base mix of silica sand and 5 per cent bentonite required about 2.6 per cent moisture to bring it to temper. The test casting (Fig. 2) had three expansion defects (rattails) on the drag surface. Two more mixes were made

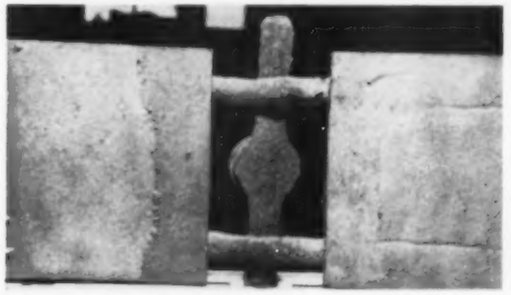


Fig. 2 . . 35% western bentonite, left; 5%, right.

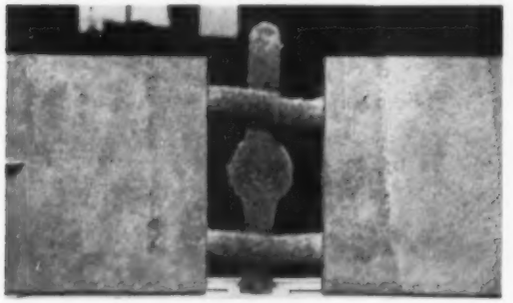


Fig. 3 . . 2½ % seacoal, left; 50% western, right.

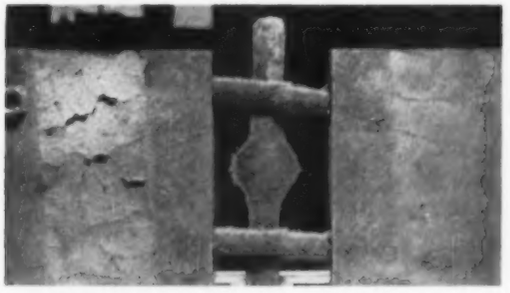


Fig. 4 . . 20% seacoal, left; 10% seacoal, right.

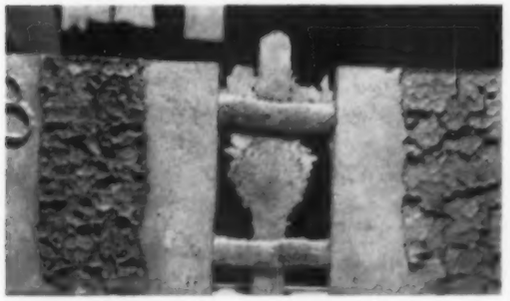


Fig. 5 . . 40% seacoal, left; 30% seacoal, right.

Fig. 6 . . 5% wood flour A, left; 2½ %, right.

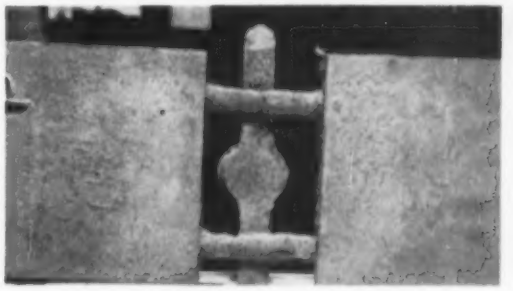


Fig. 7 . . 20% wood flour A, left; 10%, right.

Fig. 8 . . 40% wood flour A, left; 40% A, right.

Fig. 9 . . 40% wood flour C, left; 30% C, right.

Fig. 10 . . 5% pitch, left; 2¼ % pitch, right.

Fig. 11 . . 20% pitch, left; 10% pitch, right.

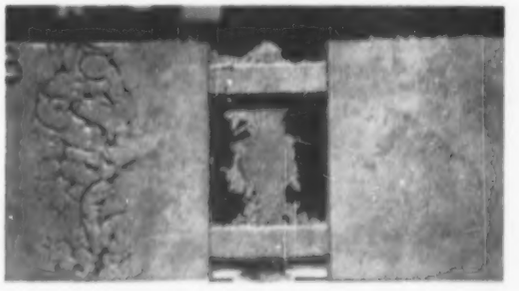


Fig. 12 . . 20% rosin, left; 10% rosin, right.

Fig. 13 . . 20% rosin cope, left; 10%, right.

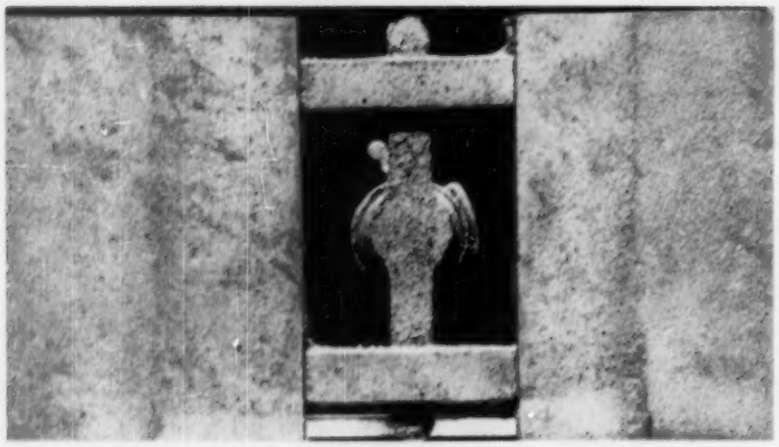


Fig. 14 . . 8% rosin A, left, and 4% A, right are similar to 2% casting.

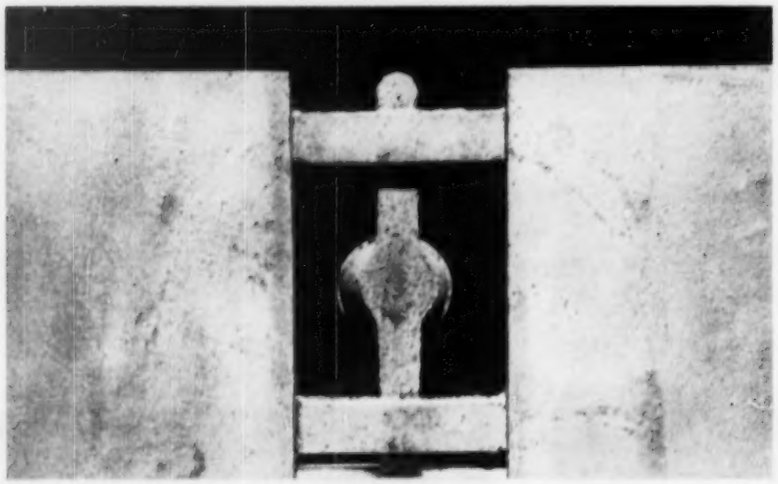


Fig. 15 . . 8% cereal lift, and 4%, right are similar to rosin tests.

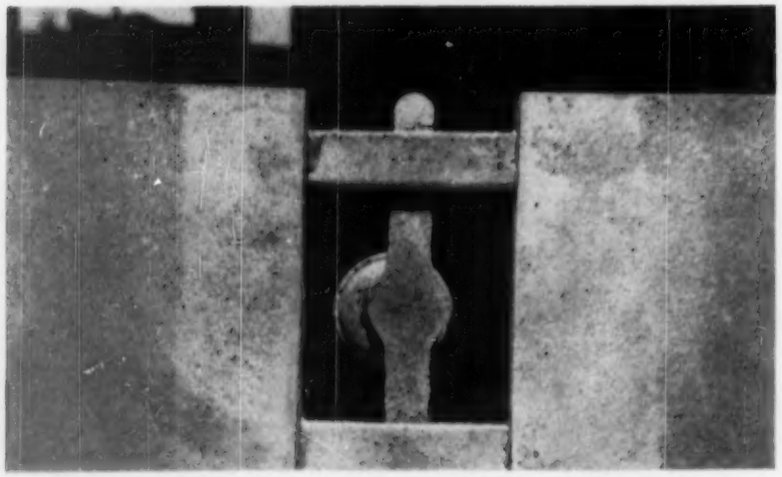


Fig. 16 . . 40% coke left; 30%, right; 20% eliminated expansion defects.

containing 35 per cent and 50 per cent bentonite. In order to bring these mixtures to temper and disperse the water throughout the clay, it was necessary to blend the water with the sand and then add the bentonite. No expansion defects were noted with the increased amounts of bentonite (Fig. 2 and Fig. 3). All three test castings were slightly rough and lighter in color indicating a tendency for the sand to burn on.

In experimenting with sea coal, test castings were made using a coarse-grind, five-screen, 47 AFS fineness number sea coal. When only 2½ per cent was added to the base mix (Fig. 3), a slight expansion defect (rattail) was present near the gate area in the drag. The casting finish was about the same as that produced by the heap sand. Additional amounts of sea coal eliminated all expansion defects. The 10 per cent sea coal mix (Fig. 4) had a smoother finish than the heap sand, but there were some evidences of excessive gas and segregation of dirt along the sides of the gates in the drag.

With 20 per cent (Fig. 4), finish was smoother, no grains of sand were noticeable, and an alligator skin finish started to appear with a few raised veins. Both the cope and drag surface were depressed into the mold cavity. There was evidence of excessive gas on both cope and drag. Thirty and 40 per cent sea coal (Fig. 5) increased the size and number of veins, gas and its dirt accumulations; the surface was still depressed into the mold cavity.

Three different kinds of prepared wood flours were compared (Fig. 6, 7, 8, 9). The test castings were very similar in appearance through 30 per cent additions. Two and one-half per cent eliminated any expansion defects. The finish, though slightly rougher was more uniform than the heap sand. There was no evidence of excessive gas. Five per cent gave a better finish than the heap sand; no gas in the drag, but some in the cope. Ten per cent gave a still better finish than the heap sand; no gas on the drag surface but considerable over the cope.

Twenty per cent showed definite erosion on both cope and drag surfaces, rough finish, and effects of gas and dirt. Thirty and 40 per cent continued the same trend, the casting was considerably larger than the mold cavity due to burning out and erosion of the surface. Here, at 40 per cent, wood flour B started showing the alligator skin effect that was similar to the 20 per cent sea coal.

Pitch (Fig. 10, 11) was used at 2½ per cent with the base mix. The finish was very smooth, similar to a shell molded casting. There was some accumulation of gas effects along the sides of the gate area, similar to the ten per cent wood flour. This unusual effect was present with all four of the pitch test castings. Five per cent was still a very smooth finish between defects along the gate and some large smooth pin holes of gas in the cope. Ten per cent pitch retained the smooth finish in the drag except for effects of gas and segregation of dirt along the gate. The cope was very dirty. Twenty per cent caused sufficient gas for the metal to still be agitated when it solidified. The cope had many dirt inclusions and some blisters.

A purchased, powdered rosin was tested in the same percentages as pitch. The test castings (Fig. 12, 13) were very similar to the pitch though the finish was not as smooth and more gas was present, indicating that rosin might possibly be used as a substitute for pitch but in smaller percentages.

A urea formaldehyde resin was used at one per cent. There were no expansion defects. The finish was uniformly rough, similar to a coarse sandpaper. Two per cent was used next. The finish, still free from expansion defects, had a smoother feel, similar to a medium sandpaper. The 4 and 8 per cent mixes (Fig. 14) were almost identical to the 2 per cent casting.

A heavy corn cereal (Fig. 15) was used in the same percentages as the urea formaldehyde; results were very similar. The casting finish was a degree or two smoother, from a medium to a fine sandpaper. Some evidence of gas was present on the cope surface in the higher percentages of cereal.

Ten per cent ground coke was mixed with the base sand. Two small expansion defects, a buckle and a rattail, were present in the gate area of the drag. The finish was coarse and rough on both cope and drag. At 20 per cent coke, the expansion defects disappeared and

the finish was still rough. Thirty and 40 per cent coke resulted in a somewhat smoother finish (Fig. 16).

All of the prepared mixes, totaling over 100, were tested in the laboratory at room and elevated temperatures. As only one mix of each kind was made, and there were no rechecks, the physical properties obtained were not conclusive.

Most additions made to a molding sand apparently tend to stabilize it and prevent expansion defects. Additions that burn easily and whose residue lacks strength should be kept below a concentration that will allow erosion to take place. Additions that produce gas should be closely controlled. They are limited to the extent that the sand can vent and the iron stay fluid until the pressure of the gas has dissipated sufficiently for all of the mold cavity to be filled with iron. Any agitation of the iron by gas flowing thru it tends to form a scum that collects and produces a dirty finish.

A loss on ignition test of a sand is not necessarily a means of determining the amount of gas that will be produced. If a synthetic sand of facing is compounded of all new ingredients, it might be satisfactory provided the potential amounts of gas produced by each component are known. One ground wood flour will produce more than another and either will produce more than the same weight of sea coal. Most sands, though, have been used and some of the carbonaceous material has been partially coked.

At one time, a molding unit operated at a very high loss on ignition, over 30 per cent for a week. This high figure was gradually attained and the carbonaceous material was mostly coke. The castings made had large, flat areas that were very susceptible to expansion defects. This unusual sand worked very satisfactorily.

Probably the most simple sand mix is the best one. With each additional ingredient, the possible variables increase. Generally, when one factor is improved, others are adversely affected. When experimenting, avoid the gradual approach, try what you think would be an excess and if it is, then decrease to determine the optimum amount to use. A gradual approach from the low side takes considerable time and you can never realize the most favorable condition until it has been exceeded.

Test castings of production mixes should be made periodically to check molding conditions. Laboratory tests may be consistent, but all of the factors are not known or tested. The ideal laboratory would be one that could exactly duplicate, under controlled conditions, all of the known molding sand properties. Such a situation isn't common and there are still some unknowns about sand.

Generally, for control purposes, only a few of the properties—moisture, permeability, green compression strength, and loss on ignition—are determined at periodic intervals. Even these few tests require considerable equipment. But, any foundry, irrespective of size or tonnage, can pour test castings either to check new products or to determine if their molding materials in use are remaining the same. Undoubtedly conditions are not constant and there is a gradual change, though any foundryman would be willing to swear "We're making them exactly the same as we did the last time, or two years ago." A review occasionally might be enlightening and profitable.

The second series of test castings affords a good opportunity to illustrate two things. First, that we still know very little about some of the properties of materials we use. Second, that by controlling the ingredients of the sand mix it is possible to exercise some control of the resultant casting.

The casting illustrated in Fig. 1 was made in a snap flask on a jolt-squeeze machine. The pattern was a flat smooth rectangular piece of ½-in. plywood with the initials in the center and draft on the sides. A small rectangular wood frame, with draft on the inside and large enough to inclose the initials and some of the center area, was placed on the pattern, filled with molding sand, and tucked slightly. The frame was removed and the outside of the pattern brushed to remove any spilled sand.

The rest of the pattern was then covered with about an inch of premix as described earlier. The flask was then filled with backing sand, jolted, and squeezed like any mold. The cope was a flat back. Two,

Fig. 17 . . 10% wood flour and 20% sea coal; C, left; B, right.

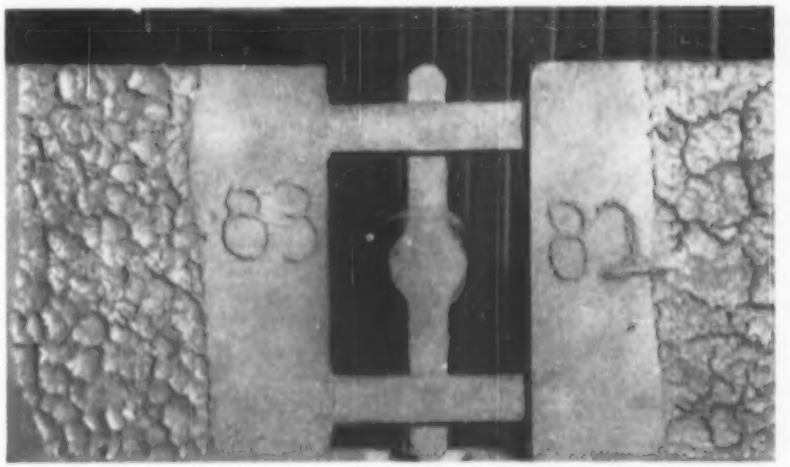


Fig. 18 . . 40% sea coal—100 mesh (155), left; 30-40-50-70 (40), right.

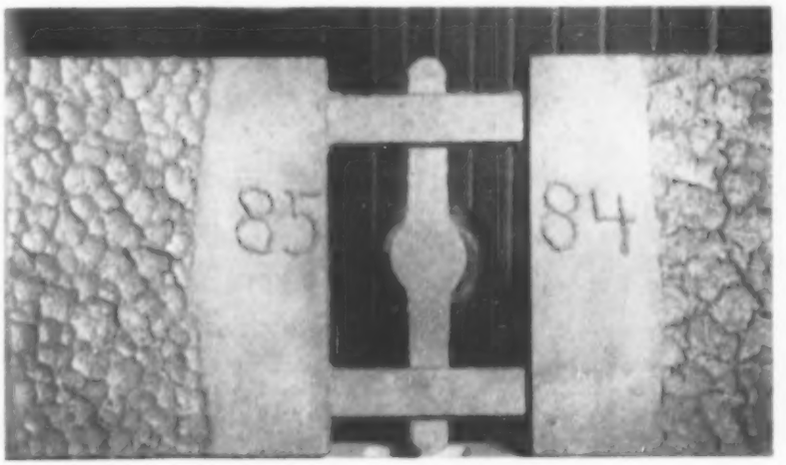
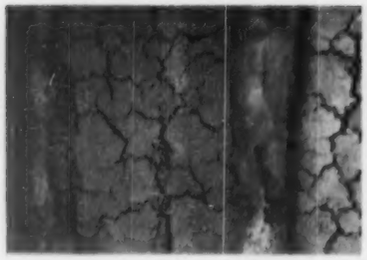


Fig. 19 . . 40% sea coal—140 mesh (175), left; 30-40-50 (30), right.



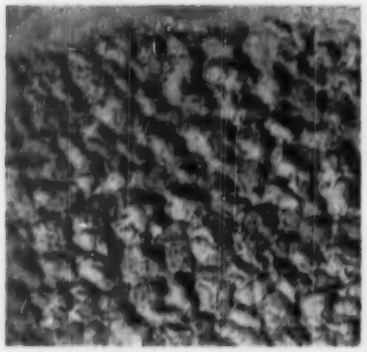


Fig. 20 (top) . . 10, 20, and 30 sec. exposures show fissuring. Fig. 21 (second down) . . Drag after cleaning. Fig. 22 (third down) . . Cope before cleaning. Fig. 23 (bottom) . . Cope after cleaning.

¼ in. thick by ¾ in. wide gates were cut from one side of the pattern to the runner. The mold was poured with the regular squeezer production iron and considerable gas was given off.

The highly veined surface is due to the coking of the sea coal. As the sea coal is exposed to heat, the free water is immediately evaporated. The volatile material starts to leave, the coal breaks open, and gases escape through the fissures. The higher melting point volatiles finally are driven off through a boiling mass of liquid pitches. The gases, breaking through this carbonaceous material, form thin skins of carbon or coke. This increases the physical size due to the expanding gases in the soft plastic mass. The whole mass then starts to shrink back as the last of the gases escape and when it has lost its plasticity, the physical shrinkage stops. The coke thus formed has sufficient strength to resist the erosive action of the iron.

Charcoal, formed from the wood flours, does not have enough strength and only the effects of erosion are present when high percentages are used. The one exception, a by-product, was probably due to the presence of other materials in its compounding. The castings made with pitch and rosin showed no veining but vast amounts of gas due to the low non-volatile material left after heating.

Combinations of 20 per cent sea coal and 10 per cent of the three different wood flours were made. The finish (Fig. 17) was very similar to the 20 per cent sea coal alone except for evidence of more gas and a slightly finer veining condition.

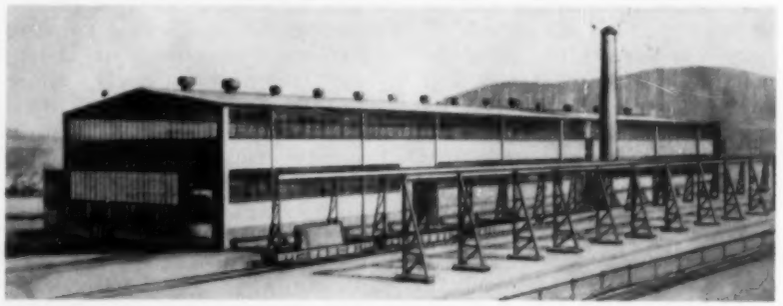
Samples of sea coal were screened and the 70 mesh and coarser was compared with the 100 mesh and finer. A second set of test castings was made with sea coal 50 mesh and coarser in contrast to 140 mesh and finer. These screened sea coals were used at 40 per cent concentration. All of them showed considerable veining (Fig. 18, 19) but in slightly different patterns. This was due to the difference in fusion and fissuring of the various sized coal with the inert sand.

To further demonstrate the cause of this phenomena, a rectangular steel frame was rammed up with a pre-mix composed of 7 parts by weight of sea coal and 2½ parts of western bentonite, and struck off flat. This was placed over a freshly poured runner box and a portion of the surface exposed to the heat for 10 seconds. The frame was then moved to expose another part for 20 seconds, and again moved over for a 30-second exposure to the heat. The 10-second exposure (Fig. 20) started many hair line cracks that were further opened up with the longer exposure to the heat. By thirty seconds, a skin had formed that raised up in the center, detaching itself from its backing though still held at the vein, similar to small pieces of orange peel laid curved side up on a flat surface.

A close inspection of a veined casting shows that, between the veins, the molding material bulged out and expanded into the mold cavity. Comparing the cope and drag (Fig. 21, 22, 23), the drag generally has numerous thin sheets of metal at right angles to the veins that have run behind the bulged-out surface. The iron at the cope surface, being less fluid and cooler, does not do this.

The author wishes to acknowledge the helpful suggestions of W. R. Jennings, foundry supt.

Chambersburg Builds New Iron Foundry



750-ton per month iron foundry has been designed for flexibility and efficiency with mechanization and good working conditions.

Nearly ten years of engineering and planning are being built into the new Chambersburg Engineering Co. iron foundry at Chambersburg, Pa., replacing facilities operating since 1906. The modern plant offering maximum economy and flexibility in the production of specification cast irons, alloy irons, and ductile irons, will be occupied in October of this year without interruption of schedules.

Monthly capacity of 750 tons will provide castings for Chambersburg's forging equipment as well as afford ample capacity to meet demands of an increasing number of casting customers. Cement-bonded sand molding and core making methods, perfected by Chambersburg engineers, will continue to be used in the production of 1000-60,000-lb castings.

The new fire-proof building, containing 48,000 sq ft of floor space, will house office and laboratory facilities for production and quality control. A large pattern shop will be separate from the foundry building. Materials and equipment will be handled in a 20,000 sq ft outside storage area by a 10-ton bridge crane.

Many foundry operations will be mechanized. Practically all foundry materials will be handled mechanically with electric trucks or conveyors. Cupola charges will be weighed and handled mechanically.

For operating flexibility and efficiency, all productive operations will be performed in one central bay, served by a 60-ton and a 30-ton bridge crane and four 5-ton gantry cranes. Incoming materials will be delivered to the sides of the building by truck or rail. Materials will then flow to the production bay as needed and work will flow to the cleaning floor at the end of the building for final processing and shipment.

Sand from shakeout and cleaning operations will be reclaimed and returned to storage by conveyor.

The entire building will be heated to insure continuous operation during inclement weather. Carefully engineered lighting will provide optimum visibility.

IS OIL QUENCHING BEST FOR PEARLITIC?

TESTS SHOW HIGHER YIELD STRENGTH AND ELONGATION WHEN OIL QUENCHED THAN WHEN AIR COOLED

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■ In view of the increasing acceptance of pearlitic malleable iron to supply the demand for a higher strength material having the general characteristics of ferritic malleable iron, attention has been drawn to the need for information to describe the wide range of properties and high quality. For most applications, and to a greater extent than many ferritic malleable or gray iron castings, pearlitic malleable iron castings are machined on all surfaces and are subjected to higher stresses.

The higher strength range (60,000-90,000 psi) of pearlitic malleable iron is obtained by varying the combined carbon content of the matrix from practically zero to 0.90 per cent. Methods of manufacture include: alloying, arrested heat treatment, and re-heat treatment from the cementite-austenite phase, just above the ferrite-cementite-austenite range.

Alloying. In order to retain combined carbon in the matrix while using the normal annealing cycle, a graphitization-retarding alloy addition, such as manganese, is made. The amount of alloy addition, metal composition, section size, and annealing cycle determine the amount of combined carbon retained. The resultant microstructure will consist of lameller pearlite, spheroidized cementite, and temper carbon nodules in a matrix of ferrite.

Arrested heat treatment is a method of stopping the heat treatment of normal composition malleable iron before all the combined carbon has been transformed to graphite. The general procedure is to air cool from the cementite-austenite range after the nucleation and growth of temper carbon nodules to eliminate primary cementite.

The amount and form of combined carbon in the resultant structure of temper carbon nodules and bulls-eye ferrite in a matrix of pearlite is progressively changed through spheroidization and graphitization by heating for a given time at a temperature below the transformation range. The resultant structure, dependent upon this draw heat treatment, consists of lameller pearlite, spheroidized cementite, or mixtures, and temper carbon nodules in a matrix of ferrite.

Re-Heat Treatment. Ferritic malleable iron or air-cooled pearlitic malleable iron re-heated to the cementite-austenite transformation range and quenched in oil or some other suitable liquid provides a material with a structure of temper carbon nodules in a matrix of martensite. In this way the hardenability characteristic of malleable composition iron is utilized to obtain a martensitic structure in all casting sections. This structure is progressively changed by means of a draw heat treatment to one consisting of spheroidized carbides and temper carbon nodules in a matrix of ferrite. Uniformity of structure found in varying sections is characteristic of this treatment.

The alloying method is hardly applicable where both ferritic malleable and several grades of pearlitic malleable are being made. Alloy additions in foundry returns adversely affect base metal composition during melting, which in turn upset annealability characteristics.

Arrested heat treatment or re-heat treatment, however, provide a means whereby one base metal composition for both irons can be altered to give the higher strengths of pearlitic malleable. The air cool treatment and re-heat-oil quench treatment result in two fundamentally different types of microstructure, dependent upon rate of cooling. Typical microstructures are shown in Fig. 1.

Because malleable irons are structurally sensitive to variations in cooling rate, standard test bars cast and processed with relatively heavier or lighter-section castings, will not necessarily develop the same structure, hardness, or properties as the castings. A relationship of mechanical properties and microstructure to Brinell hardness affords a convenient, non-destructive means for determining casting quality through hardness tests. American Society for Testing Metals, Society of Automotive Engineers, and government specifications for pearlitic malleable iron include both minimum physical properties and typical Brinell ranges.

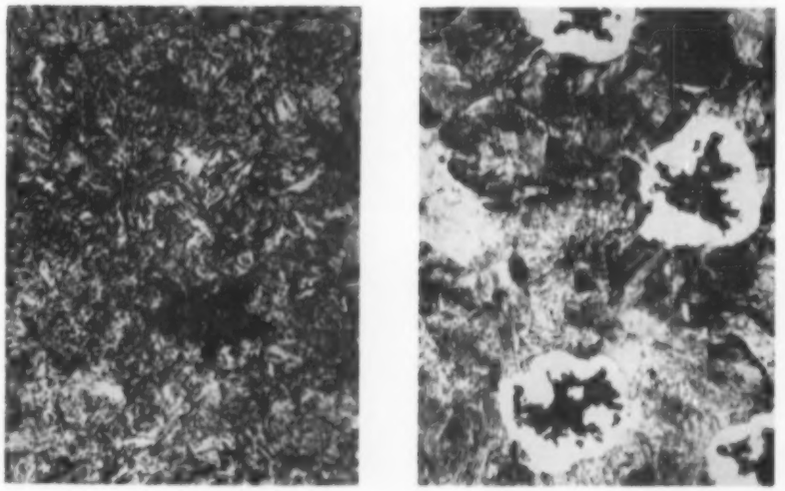

Fig. 1 . . Typical microstructures of oil-quenched (left) and air cooled (right) pearlitic malleable iron. 500X, appx. ¾ size.

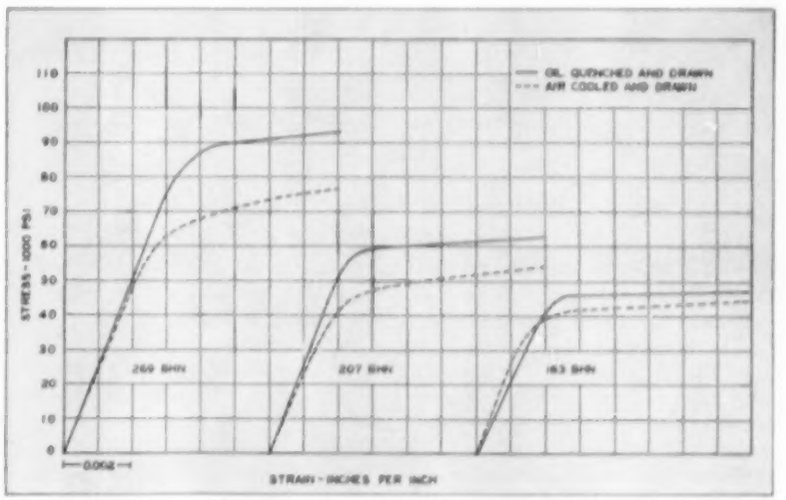

Fig. 2 . . Oil quench and draw produce greater toughness.

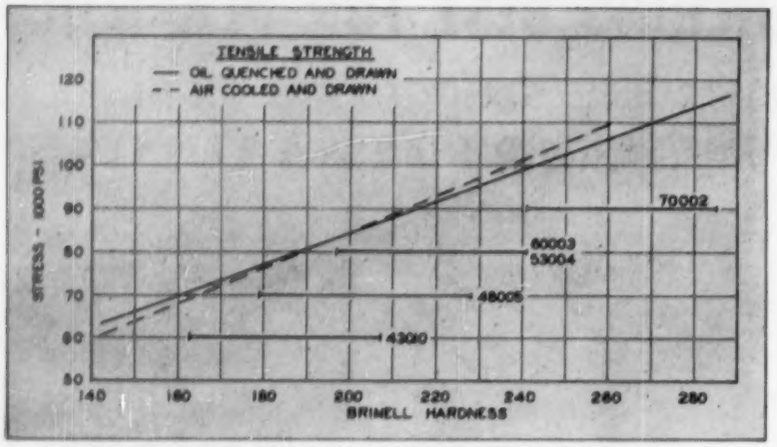

Fig. 3a . . Best straight line relationships of tensile strength . . .

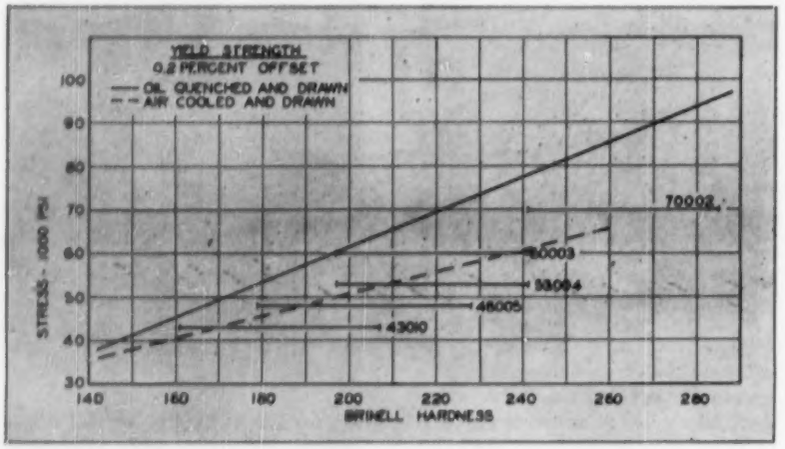

Fig. 3b . . yield, and elongation with hardness were . . .

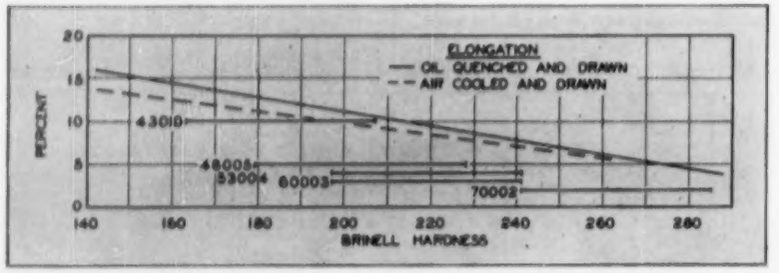

Fig. 3c . . determined by the method of least squares.

It is of interest that the present machinability ratings of pearlitic malleable iron based on the Taylor speed criterion are also reported for Brinell hardness ranges. The purpose of this paper is to correlate and to describe observed relationships of mechanical properties and machinability to the type of microstructure found in air-cooled and oil-quenched malleable iron drawn to various hardnesses. Conclusions were based on the results of tests on standard 0.625-in. test bars machined to 0.505 in. diam. and from 4 x 4 x ¾-in. machinability blocks of the following chemical composition: C, 2.42 per cent; Si, 1.67; Mn, 0.44; S, 0.165; Cr, 0.030; and P, 0.04.

Heat Treatment. Thirty pairs of test bars were subjected to first stage heat treatment in a controlled atmosphere, continuous-type furnace and air cooled by forced convection to an average Brinell hardness of 285. Fifteen pairs were then reheated to above the critical and oil quenched to obtain a fully martensitic matrix of 600 Bhn.

Ten pairs of air-cooled and ten pairs of oil-quenched test bars were placed in a draw furnace at 1320 F (716 C). An oil-quenched and an air-cooled test bar were withdrawn together from the furnace at 30-min. intervals, after 1 hour at temperature and continuing for 9 hours. Resultant Brinells were 223 to 156 for oil-quenched and drawn and 143 to 229 for air-cooled and drawn bars.

To obtain material at the higher hardness range of 321-248 Bhn, the remainder of the test bars were placed in the furnace at 1220 F (660 C), and withdrawn at 30-min intervals after 45 minutes at temperature.

It was thus possible to obtain material with Brinell hardnesses from 321 to 143, a range which completely spans typical hardnesses (285-163 Bhn) reported in A.S.T.M., S.A.E., and government specifications for pearlitic malleable iron.

Mechanical Properties. Initial experimentation of setting up draw heat treatment cycles indicated considerable unpredictable variation in mechanical properties in unmachined test bars, particularly with respect to yield strength and elongation. This variation was attributed to a minor out-of-round condition in cast bars and to warpage which resulted in too great a departure from axial loading while testing. Consequently, bars were machined from 0.625 to 0.505-in. diam.

The bars were tested in tension in a hydraulic testing machine of 60,000-lb capacity, equipped with serrated grips. Strain measurements on one bar from each pair were made at each 100 pounds applied load with SR-4 strain gages cemented longitudinally onto the specimen. The free load cross head speed was 0.007 in./min. Yield strengths at 0.1 and 0.2 per cent offset, and yield points at 0.5 and 1.0 per cent total extension were obtained from the derived stress-strain curves. Typical stress-strain curves are shown in Fig. 2. Mates to these bars were tested at a free load cross head speed of 0.033 in./min; yield points were determined by dividers method at 0.5 and 0.1 per cent total extension.

Complete tension testing results together with Brinell hardness made on the center of a transverse section of the grip end of the test bar are shown in Tables 1 and 2. Odd numbered bars were tested with SR-4 strain gage, while data for even

Table 1 . . Mechanical Properties of Air-Cooled and Drawn Test Bars

Test Bar No.	Bhn	Tensile Strength psi	Yield Strength (psi) Total Extension 1.0%	0.5%	Offset 0.2%	0.1%	Elongation Per Cent
41	293	122,100	.....	.....	.....	.....	4.0
42	293	118,800	86,100	.....	.....	.....	3.0
43	...	116,700	83,700	.....	.....	.....	3.5
44	285	118,000	.....	.....	.....	.....	4.0
45	269	118,800	80,000	71,500	71,000	67,000	5.0
46	269	114,000	76,600	.....	.....	.....	5.0
47	262	109,100	74,200	66,200	66,000	63,000	6.0
48	262	107,000	76,800	.....	.....	.....	6.0
49	255	110,200	72,500	65,800	65,000	61,000	8.0
50	248	109,200	71,900	.....	.....	.....	6.5
1	217	92,200	59,400	53,000	51,100	48,200	7.5
2	229	95,600	64,600	57,200	.....	.....	7.5
3	207	88,200	55,900	50,500	49,100	47,200	10.5
4	217	92,500	64,400	55,800	.....	.....	10.0
5	207	85,800	56,000	51,000	49,800	47,600	7.0
6	202	87,700	60,000	53,100	.....	.....	8.0
7	192	82,000	54,400	50,100	49,400	48,000	..
8	202	83,100	59,500	54,400	.....	.....	9.0
9	179	74,100	48,900	45,800	44,900	43,000	11.0
10	179	75,000	53,200	49,300	.....	.....	11.0
11	174	73,500	47,900	44,000	43,000	41,900	9.0
12	179	75,500	52,500	48,000	.....	.....	13.5
13	170	73,300	48,200	44,800	43,800	42,200	14.5
14	170	71,600	50,000	45,800	.....	.....	13.0
15	163	67,500	46,000	43,100	42,300	41,000	12.0
16	163	67,700	48,200	43,800	.....	.....	15.0
17	149	61,600	41,900	39,100	38,200	36,500	12.0
18	149	66,000	45,300	41,800	.....	.....	16.0
19	143	61,000	40,000	37,200	36,500	34,200	15.5
20	146	61,000	43,600	41,200	.....	.....	16.0

numbered bars were obtained by means of dividers. The relationship of tensile strength, yield strength (0.2 per cent offset), and elongation to Brinell hardness, shown in Fig. 3, was obtained by the method of least squares to determine the best fitting straight line through the experimental data.

Microspecimens were taken ½ in. from the fracture on bars of representative hardnesses over the entire hardness range (163-285 Bhn) to illustrate the progressive change in microstructure and the effect on mechanical properties with heat treatment. Photomicrographs at 163, 187, 207, and 241 Bhn for oil-quenched and drawn, and air-cooled and drawn pearlitic malleable iron are shown in Fig. 4.

Machinability test coupons were 4 x 4 x ¾-in. blocks, cast and processed under the procedures used in the preparation of the tensile test bars. Some blocks were re-heated to 1570 F (854 C) and oil quenched to obtain a fully martensitic matrix. Others were retained in the air-cooled condition after first stage anneal. All were drawn for varying times at 1200 F (649 C) to secure hardnesses of 262 to 137 Bhn.

One-eighth inch of metal was removed from the cope surface of each block, preparatory to drill testing, to expose uniform interior metal and to eliminate surface factors. Brinell impressions were made on the cope surface after the removal of the eighth-inch of metal, and microspecimens were taken ½ in. from the edge opposite the gate.

Drilling tests were conducted at the University of Michigan Metals Processing Laboratory with ⅛ in. diam., high-speed steel, ferric oxide-coated drills of approximately 3 in. flute lengths, 0.051-0.055 in. web thicknesses, ground on a drill grinder for a relief angle of 6 degrees. Drills were mounted in a 25-in., box-column, upright drill press. Standard conditions of speed and feed were 480 rpm and 0.007 in./min.

A floating vise was mounted on the drill press in such a way that the thrust component of power could be determined by means of SR-4 strain gages, while the torque component was determined from changes in a magnetic field caused by a core mounted to the vise support moving within a separately supported coil. These electrical impulses were amplified and automatically recorded on strip charts. Previous to drill testing, the equipment was standardized for torque and thrust by means of a torque bar and pressure gage respectively.

In order to compensate for any slight dimensional variations in web thicknesses, chisel edges, cutting edges, or concentricities of the drills and also to remove any personal

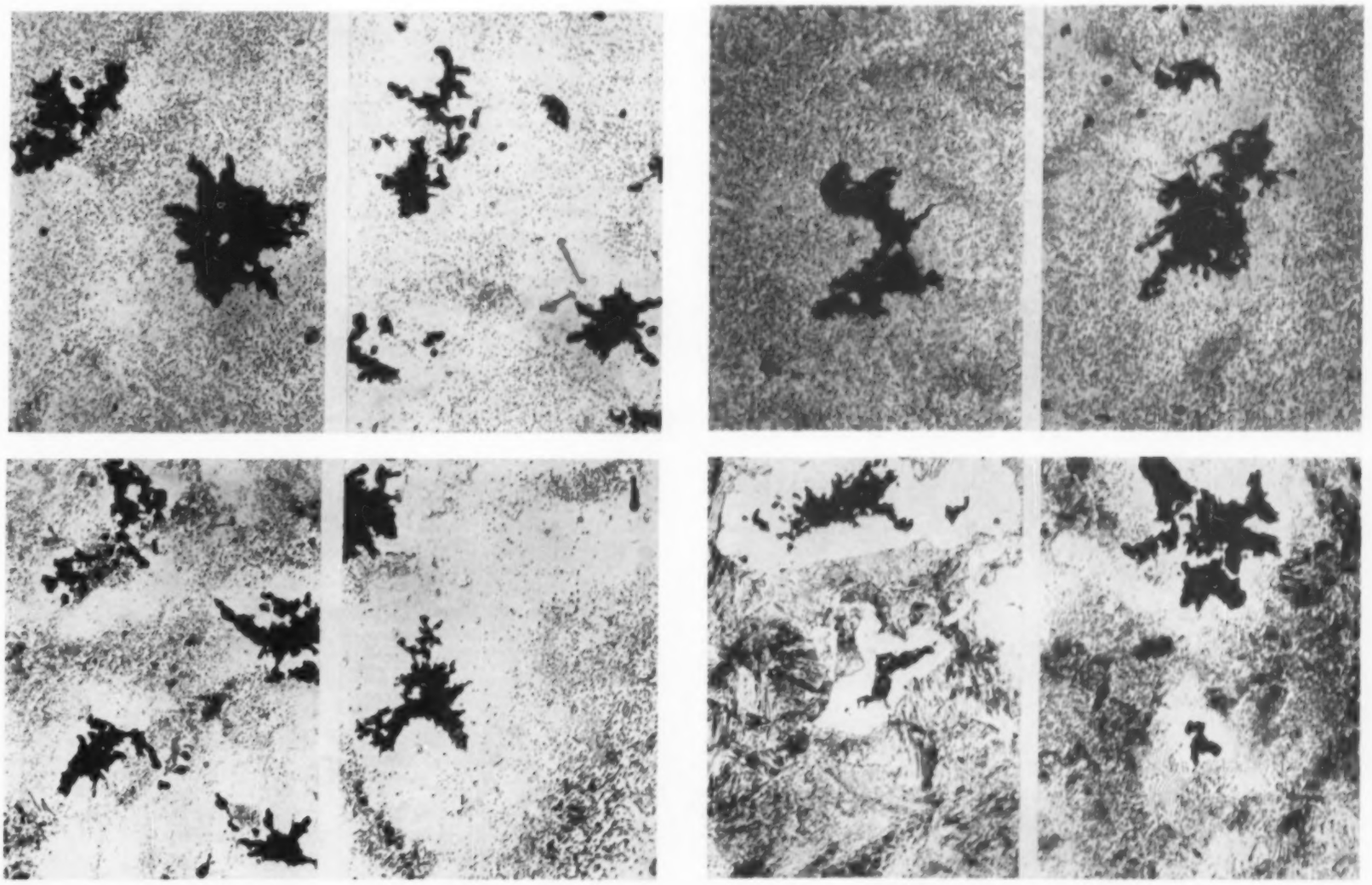

Fig. 4 . . Typical microstructures of pearlitic malleable iron, oil quenched (top) and air cooled (bottom), and drawn to Brinell hardness of . . . (left to right) 241, 207, 187, and 163. Softening is mainly due to second stage graphitization with minimum carbide coalescence. 500X, reduced to ¾ size.

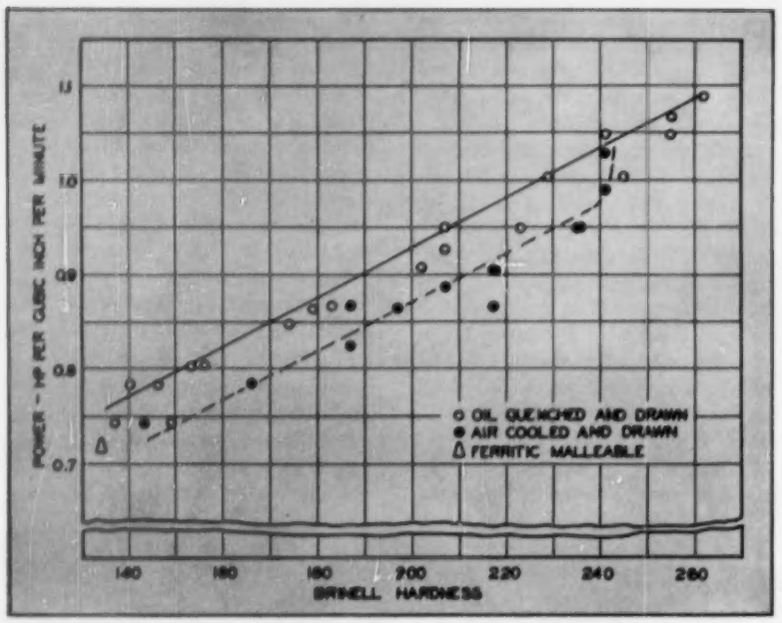

Fig. 5 . . Machining power related to hardness of heat treatments.

bias, test blocks were randomly arranged in groups of ten. Using one drill, a single hole was drilled in each of the blocks within one group. Repeating this procedure for each of the other three drillings provided values of torque and thrust for four independently drilled holes in each block. Before proceeding to the next group, drills were resharpened.

The range of values for torque or thrust from any one test block could be compared with those obtained from any or all the others to insure the absence of assignable causes for variation. As there was no indication of assignable causes for variation, torque or thrust values were averaged to obtain the best estimate of their true value. Averaged values for torque and thrust were converted to units of horsepower developed to remove a cubic inch of metal per minute by means of relationships contained in related reference materials.[1] Unit horsepower determinations together with Brinell hardnesses are given in Table 3; shown graphically in Fig. 5.

Due to the similar microstructure of a pearlitic malleable machinability block and a test bar drawn to the same hardness, the expected yield strength (0.2 per cent offset) of a machinability block was determined from its Brinell hardness by means of Fig. 3. The relationship of unit horsepower to yield strength is shown in Fig. 6.

After the solution of primary cementite and the nucleation and growth of temper carbon nodules from the as-cast structure, which is accomplished during first stage anneal, the structure of the matrix can be changed to any of the forms described in the literature on steel by variation of cooling rate and draw heat treatment.

Microstructure. Two fundamentally different types of microstructure determined by the rate of cooling are obtained prior to the draw operation. Cooling in air (a relatively slow rate of cooling) produces a microstructure of temper carbon nodules surrounded by bulls-eyes of ferrite in a matrix of lameller pearlite (Fig. 1—right). By reheating material of this microstructure to above the critical temperature, transforming pearlite into austenite, and quenching in oil (a relatively fast rate of cooling), a microstructure of temper carbon nodules in a matrix of martensite is formed (Fig. 1—left). The distict difference in hardness, 285 Bhn for the air-cooled structure and 600 Bhn for the oil-quenched structure, is a result of the form in which the carbon (other than temper carbon or graphite) is distributed.

The rate of decrease in hardness during the initial stages of the draw heat treatment of oil-quenched iron is greater than in air-cooled iron. However, this difference exists only until a hardness of about 241 Bhn is reached; then the rate of softening appears to be similar for both structures. Bain,[2] in his discussion on Engel's work,[3] describes a similar occurrence in 0.94 per cent carbon steel when drawn at 1200 F (649 C). The higher rate of softening is attributed to initial structural changes occurring more rapidly in martensitic-type structures.

The softening of a graphite-free, martensitic structure is due to the increase in Fe_3C particle size, together with strain release of the ferrite. Fe_3C tends to change toward the condition of apparent maximum stability which is in the form of spheroidized carbide. However, due to the chemical composition of malleable iron and the presence of temper carbon nodules, second stage graphitization competes with the tendency toward coalescence of Fe_3C, both contributing to softening.

In general, softening of the pearlitic matrix proceeds in a similar manner; that is, coalescence of Fe_3C together with the strain release of ferrite. Due to the presence of some lameller pearlite at any hardness within the pearlitic malleable range, air-cooled and drawn material can be distinguished from that originally having a fully martensitic structure, i.e., oil-quenched and drawn.

Persistence of lameller pearlite is typical of a draw heat treatment temperature below the critical, and is the reason why it is difficult to spheroidize the coarser lamellae of carbide without heating into the austenite range. Microstructure of air-cooled and drawn iron of 241-163 Bhn shown in Fig. 4 indicates softening, for the most part, is the result of second stage graphitization with a minimum of carbide coalescence, as evidenced by the persistence of lamellar pearlite and the smaller size and amount of coalesced carbide.

Mechanical Properties. It is to be emphasized that air-cooled and oil-quenced pearlitic malleable iron of essentially the same chemical composition will have different microstructures. Although these microstructures will respond in a similar manner to draw heat treatment to the same hardness, a difference in microstructure will persist, and differences in mechanical properties are to be expected.

A constant relationship (with small deviation) between hardness

Table 2 . . Mechanical Properties of Oil-Quenched and Drawn Test Bars

Test Bar No.	Bhn	Tensile Strength psi	Yield Strength (psi) Total Extension 1.0%	Offset 0.5%	Offset 0.2%	Offset 0.1%	Elongation Per Cent
51	321	127,700	112,700	103,000	109,500	105,800	3.5
52	321	128,200	118,000	.....	.....	.....	2.0
53	285	117,900	100,200	95,500	97,500	95,000	5.0
54	277	116,100	97,700	.....	.....	.....	4.5
55	269	111,000	93,000	89,000	91,000	88,200	5.0
56	269	112,000	92,200	.....	.....	.....	6.5
57	262	114,000	88,000	85,200	86,200	84,300	4.0
58	262	107,800	89,300	.....	.....	.....	6.0
59	255	105,600	83,800	81,900	82,000	79,800	7.5
60	248	100,400	80,200	.....	.....	.....	6.5
21	223	95,400	74,100	73,200	73,100	72,200	7.5
22	229	96,600	79,500	77,600	.....	.....	6.0
23	217	91,000	69,000	68,200	68,200	67,600	7.0
24	212	93,700	71,200	70,200	.....	.....	8.0
25	207	88,800	65,000	63,000	62,600	62,000	11.0
26	207	90,600	67,000	66,000	.....	.....	12.0
27	202	83,000	62,000	60,900	60,700	60,500	11.5
28	207	86,200	63,600	63,100	.....	.....	12.0
29	197	83,400	60,100	59,000	58,700	58,500	11.5
30	202	85,200	63,000	62,100	.....	.....	13.0
31	192	82,400	58,700	58,200	58,200	58,100	13.0
32	202	82,700	61,600	60,600	.....	.....	13.0
33	183	79,200	56,000	56,000	56,000	56,000	14.0
34	187	80,700	59,900	58,900	.....	.....	15.0
35	183	77,700	54,200	53,900	53,800	53,500	14.0
36	183	77,600	57,500	56,500	.....	.....	14.0
37	163	68,100	47,000	46,800	46,800	46,800	15.0
38	163	69,700	51,600	51,100	.....	.....	15.5
39	156	65,900	46,100	45,000	44,900	44,200	14.0
40	163	69,700	51,400	50,400	.....	.....	15.0

and tensile strength, yield point, and elongation of a number of oil-quenched or water-quenched steels drawn to various identical hardnesses is reported by Janitzky and Baeyertz.[4] That such a relationship can also be developed by oil-quenched malleable iron is most probable when the presence of temper carbon nodules of graphite is recognized as essentially the only difference in structural constituents. Differences in carbon and silicon in solution would not be expected to destroy the probability of this relationship. However, in consideration of investigation by Schneidewind and Reese,[5] variations in metal composition and heat treatment can be expected to cause deviations from the relationships shown in Fig. 3.

Get Different Properties

Significant deviation in mechanical properties between oil-quenched and drawn and air-cooled and drawn test bars at the same hardness are evident in Fig. 3. Most apparent is the increasing difference in yield strength as the hardness increases from 163 to 285 Bhn. The difference in yield strengths is least at 163 Bhn because the microstructure (Fig. 4) in either case is approaching that of fully annealed ferritic malleable iron which, for cupola-air furnace duplexed iron of this foundry is 37,500 psi at 140 Bhn.

Stress-strain curves of Fig. 2 indicate a sharp-kneed diagram results from oil-quenched and drawn test bars, while a more rounded knee is obtained for air-cooled and drawn test bars. Plastic deformation commences at a higher applied stress for oil-quenched material at the same hardness as air-cooled. This is attributed to the difference in distribution and arrangement of ferrite and cementite. The greater area contained under an oil-quenched, stress-strain curve indicates the superior toughness of this material at the same hardness as air-cooled. The average modulus of elasticity in all cases is approximately 26×10^6 psi.

Machinability. Present machinability ratings are based on Taylor speed, which refers to the surface speed at which the metal can be cut permitting a definite tool life. Taylor speed for AISI-B-1112 Bessemer free-cutting steel is considered as 100 per cent. Pearlitic malleable iron on the Brinell hardness range 180-200, is reported as 90 per cent, and in the 200-240 range as 80 per cent.[6] The indefiniteness of these ratings is apparent by the recent incorporation of machinability power requirement in specifications for pearlitic malleable iron. While microstructure is generally recognized as a controlling factor on machinability, there is no description of microstructure for Taylor speed ratings of pearlitic malleable iron.

Machinability vs. Microstructure

Recognition that metal cutting involves plastic flow plus either tensile or shear failure suggests a probable relationship of machinability to mechanical properties of material as determined by micro-structure.

An investigation has been initiated to determine the effect of different type microstructures and resultant mechanical properties on the power required to remove a specific amount of metal per unit time. A general linear relationship of Brinell hardness to unit power shown in Fig. 5 indicate that power increases with hardness. A significant change in the relationship occurs at 241-235 Bhn in the air-cooled and drawn material. A typical micro-structure at this hardness is shown in Fig. 4. This change is attributed to the relatively uninterrupted distribution of pearlite, the subsequently increased strength and hardness of this type matrix, and its resistance to cutting.

Figure 3, yield strength and per cent elongation in particular, indicates that, at the same hardness, oil-quenched and drawn pearlitic malleable iron has greater toughness, suggesting a higher power requirement to remove metal. The data of Fig. 5 together with reported power requirements of turning tests support this contention.

However, this hardness-power correlation does not take into account the factors of structure and mechanical properties. Correlation of yield strength (0.2 per cent offset) to unit power is shown in Fig. 6. In this case power requirements for both air-cooled and oil-quenched pearlitic malleable iron converge to that determined for completely annealed ferritic malleable iron. This is to be expected, as both the microstructures and mechanical properties have been previously shown to approach that of ferritic malleable iron at 140 Bhn. The divergence at the higher values of yield strength is attributed to the different type microstructures (Fig. 4) and resultant strength relationships (Fig. 3). Oil-quenched and drawn pearlitic malleable iron will have lower tensile strength or hardness at the same yield strength than when air-cooled and drawn, and offer less resistance to cutting.

This would indicate that, on the basis of improved machinability, oil-quenched and drawn pearlitic malleable iron could be used for A.S.T.M. grades 53004, 60003, and 70002 if design specifications are primarily on yield strength, which would appear most likely, rather than tensile.

Conclusions. On the basis of the work described in this paper the following conclusions have been drawn:

1. Mechanical properties of pearlitic malleable iron depend upon the quality, size, shape, and distribution of the structural constituents.
2. There exists a relationship between hardness and microstructure that permits the prediction of mechanical properties.
3. Oil-quenched and drawn pearl-

Table 3 . . Machinability Data

Test Block No.	Bhn	Unit Horsepower HP/in.³/min
	Oil-Quenched and Drawn	
45	262	1.094
46	255	1.073
47	241	1.053
48	229	1.011
49	207	0.950
50	183	0.867
51	174	0.847
52	156	0.805
53	153	0.804
54	146	0.784
55	255	1.053
56	241	1.011
57	223	0.950
58	207	0.929
59	202	0.908
60	179	0.866
62	149	0.744
63	140	0.784
64	137	0.743
	Air-Cooled and Drawn	
69	241	0.991
67	235	0.950
68	217	0.908
65	217	0.867
66	197	0.867
70	241	1.032
71	235	0.950
77	217	0.908
73	207	0.888
80	187	0.826
79	187	0.867
76	166	0.785
74	143	0.743
	Ferritic Malleable	
81	134	0.724

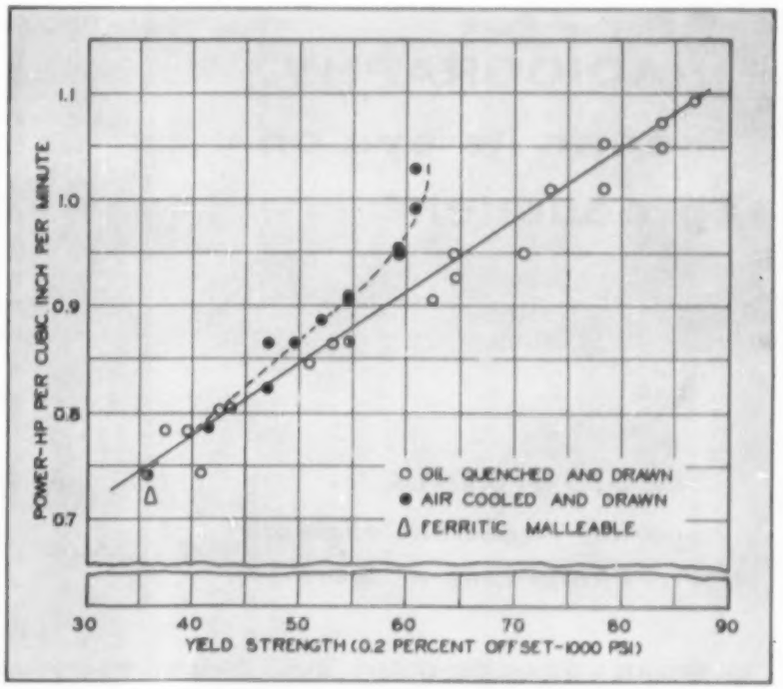

Fig. 6 . . Machining power related to yield strength and treatments.

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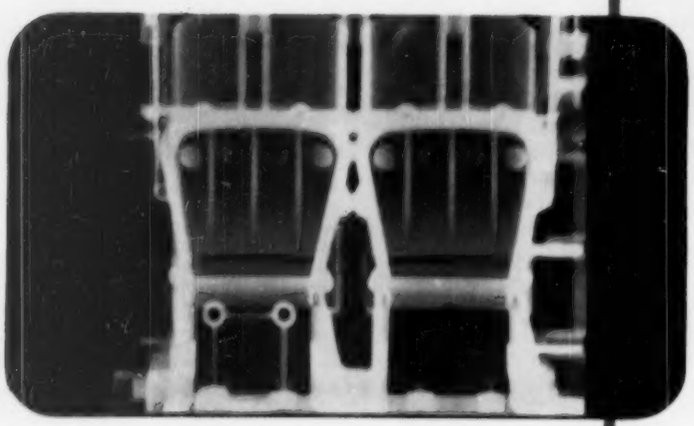

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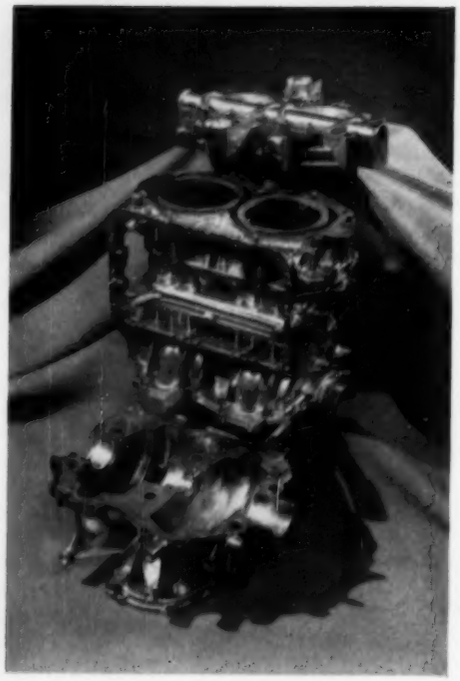

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itic malleable iron at the same hardness as air-cooled and drawn exhibits approximately the same tensile strength, but higher yield strength and greater elongation.

4. Machinability, evaluated from drilling tests and expressed as horsepower to remove a cubic inch of material per minute, appears to be a function of yield strength. Power increases at approximately the same rate for both air-cooled and drawn and oil-quenched and drawn ferritic malleable over the average yield strength range of 37,500 psi to approximately 50,000 psi. Above 50,000 psi the power requirement for air-cooled and drawn malleable iron increases rapidly while that for oil-quenched and drawn continues to increase at a uniform rate.

Acknowledgment. Grateful acknowledgment is made to Dr. F. B. Rote, technical director, Albion Malleable Iron Co., for his interest, encouragement, and constructive criticism and to the management for permission to publish the results.

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JAMES E. HOLLY/*Hose Development Engineer*
Thermoid Co., Trenton, N. J.

DO	WHY
1. Use correct hose for material carried.	Pumping acids, for instance, through a water hose will cause hose leakage and eventual failure with damage to equipment and personnel.
2. Use hose of correct pressure capacity.	Too high pressure will weaken hose and cause failure with possible damage to equipment and injury to personnel.
3. Select couplings carefully as to type, size and material and install correctly.	A poor connection means leakage, poor performance and possible failure.
4. Have shut-off valve accessible.	To stop flow quickly in case of sudden or accidental failure of hose or coupling.
5. Avoid excessive lengths.	Excessive lengths present a tripping hazard to personnel.
6. For steam, use a wire braid hose or hose specifically designed for steam.	Steam under pressure will burn and weaken an ordinary hose resulting in bursting, with damage to equipment and injury to personnel.
7. Tighten couplings periodically.	Prevent leakage and eventual failure at coupling.
8. Repair cuts, worn spots as soon as discovered.	Will prevent sudden, complete rupture later.
9. Use enough hose to reach.	Pulling and stretching hose will weaken it, especially at couplings; with eventual failure and spillage of material carried.
10. Wear protective clothing (goggles, rubber gloves, apron) when handling hot or corrosive material in a hose.	Protect workers' eyes, skin and clothing against contact with material in case of spattering or failure.
11. Check hose for breaks, loose couplings before using.	Accident prevention is more efficient than first aid.
12. Protect hose from accidental damage from vehicles, falling objects.	Will weaken and damage hose.

Avoid excessive lengths.

Keep hose away from hot surfaces and heat outlets.

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13. Provide means of stopping flow when handling corrosive or hot materials by means of valves or nozzles.	Quick stopping of flow may be required in an emergency.
14. When handling inflammable materials such as gasoline be sure it has a ground wire.	Prevent sparking from static electricity.
15. Know your hose types and particular applications.	Knowledge of hose and correct applications will eliminate accidents caused by using wrong hose.
16. Watch the bending radius.	Continuous bending below allowable limit will weaken hose at bend and cause eventual failure.
17. When using nozzle under high pressure, increase pressure gradually and grip nozzle firmly.	Prevents hose whip and spillage of material.
18. Keep hose away from hot surfaces and heat outlets.	If material carried is inflammable, it may ignite. Will damage hose and cause rupture with spillage of material.

Use enough hose to reach.

19. Never hang hose on a nail, where it is forced to take a sharp bend.	Continued undue strain can result in permanent deformation and cracking.
20. Store hose on flat surface (shelf, floor, etc.) in cool room, not exposed to direct sunlight.	High temperatures and direct sunlight will tend to cause premature aging of rubber and possible sudden rupture when used.
21. Use valve or shut-off nozzle to stop flow of material.	Kinking of hose to stop flow through it may rupture carcass and cause burst at low pressure.

Check hose for breaks and loose couplings before using.

Protect hose from accidental damage from vehicles and falling objects.

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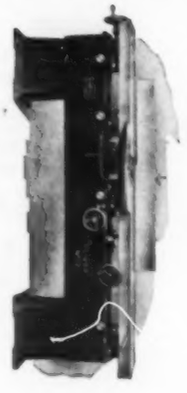


Here's one reason why this "Oliver" Jointer is the patternmaker's favorite: the front table tilts sideways up to 5° for planing draft on lumber. The No. 12 makes easy work of planing long and short pieces of lumber. Tables adjustable for ⅛" cut. Fence adjustable from square to 45° across table. Has new rabbeting attachment. Sturdy cabinet columns eliminate vibration. Three sizes: planes 20, 24, 30 inches wide. Write for Bulletin No. 12.

"Oliver" also makes heavy Jointers in 12" and 16" sizes, and the smaller 8" and 6" sizes.

OLIVER MACHINERY COMPANY
Since 1890 Grand Rapids 2, Mich.

For more facts, circle No. 95 p. 103-104

foundry trade news

Wheelco Instruments Div., Barber-Colman Co., Rockford, Ill., has moved into new and expanded facilities at 6610 North Sheridan Rd., Chicago. The new telephone number is BRiargate 4-9705.

Howard Foundry Co., Chicago, has published a bulletin entitled *"The Ellis Casting Process."* The bulletin stresses the use of the process for the production of microwave fittings, but all types of complex investment cast parts can be produced by the process.

Exothermic Research Products, Inc., Buffalo, N. Y., has consolidated with **Exomet, Inc.,** Conneaut, Ohio. Exomet will manufacture and market all products of Exothermic Research formerly made in Buffalo.

American Steel Foundries, Inc., Chicago, for the second straight year, has made a $1000 grant to the Illinois Institute of Technology to foster foundry education at the Institute. The presentation was made to the IIT metallurgical engineering department through the Foundry Education Foundation of Cleveland.

Behr-Manning Div., Norton Co., Troy, N. Y., received the 1954 National Safety Council's Award of Honor. To earn it, nearly 2000 employees worked nearly 4,000,000 man-hours with only 12 lost-time or disabling injuries, equivalent to a man's working 165 years per injury. Behr-Manning attained a frequency of injury 69 per cent better, and a severity rate 90 per cent better, than the average for its industry.

Precision Castparts Co., Portland, Ore., has moved into its new 48,000 sq ft plant at 5001 S. E. Johnson Creek Blvd., Portland. The new foundry will have more than double the capacity of the company's present operating facilities and will include a complete battery of tool and die making equipment, ranging from lathes and mills to contour-duplicating devices.

Lebanon Steel Foundry, Lebanon, Pa., has published a sales bulletin on Ceramicast, a new casting process. Ceramicast utilizes ceramic molds to produce castings with smooth surfaces, intricate shapes, thin metal sections, close tolerances, reduced machining costs, and reduces or eliminates machining.

Foxboro Co., Foxboro, Mass., has established ten regional sales divisions. The new sales regions are effectively integrated with Foxboro's newly expanded service and manufacturing facilities, new branch factories having been constructed in Dallas, Texas; Pittsburgh, Pa.; and San Leandro, Calif.; during the past year.

S. D. Fuller & Co. and **Vermilye Brothers** are offering to the public 99,880 shares of common stock of **Schmieg Industries, Inc.,** Detroit, Mich., at $3.00 per share, less a concession of 45 cents per share. The proceeds of the sale will be used to improve and develop the company and to expand its sales which have increased by 200% during the past four years.

Recent acquisitions by **American Steel Foundries,** Chicago, in non-railroad fields accounted for 60 per cent of the organization's total net income in 1954, even though they were responsible for only 38 per cent of the sales volume. The diversification acquisitions were purchased with $20,000,000 of ASF capital which had been retained in the business from earnings.

Advance Aluminum Castings Corp., Chicago, has published its annual report for 1954.

Morris Bean & Co., Yellow Springs, Ohio, has published an informative bulletin entitled *"Antioch Process Aluminum Alloy Castings Fluid Flow."*

The metallurgists of **Precision Metalsmiths, Inc.,** Cleveland, Ohio, a leading producer of ferrous and nonferrous investment castings, have prepared a *"Chart of Standard Investment Casting Alloys."* The chart is designed to act as a ready reference guide for all engineers concerned with the selection or specification of investment castings.

Otto H. Rosentreter Co., South Gate, Calif., is handling the sales of equipment manufactured by **Shell Process Inc.,** Chicopee, Mass., on the West Coast.

American Pulley Co., Philadelphia, has purchased the assets of **Safeway Industrial Equipment Corp.,** Chicago, manufacturer of a complete line of manually and electrically operated hydraulic lift trucks. It is planned to merchandise these lift trucks under the trade name of "American Safeway."

Claud S. Gordon Co., Chicago, has announced the completion of addi-

continued on page 119

CASTING through the Ages

EXACTLY 100 YEARS AGO THIS JULY 4th, RICHARD T. CRANE, FOUNDER OF CRANE CO., CELEBRATED THE COMPLETION OF THE TINY FRAME FOUNDRY HE HAD BUILT HIMSELF, BY CASTING SOME LIGHTNING ROD TIPS AND COUPLINGS IN MOLDS MADE OF SAND HE HAD TURNED UP WHILE EXCAVATING FOR HIS FURNACE!
R.T. CRANE BRASS & BELL FOUNDRY
1,861 POUNDS OF HOUSE HOLD UTENSILS AND OTHER METALLIC OBJECTS WERE DONATED BY PROUD VILLAGERS TOWARDS THE CASTING OF A CHURCH BELL AT BRIDGEWATER, ENGLAND IN 1284
Odd Bits
ABOUT THE TIME OF THE AMERICAN REVOLUTION, A BOATMAN, EQUIPPED WITH AN OYSTER RAKE, COULD SCOOP UP, EACH DAY, ABOUT TWO TONS OF BOG IRON ORE FROM THE BOTTOM OF THE ASSAWOMPSETT POND LOCATED IN MASSACHUSETTS!
BOTH THE BELLS OF KING'S COLLEGE, CAMBRIDGE — AND ITS COOKING UTENSILS — WERE CAST BY THOMAS CHYCHE, IN 1500!

59th AFS convention

how to improve

Competitive Position of Castings

Better production techniques . . . effective management controls . . . design factors . . . solutions to cost problems . . . are given in this conclusion to *Modern Castings'* report on the 1955 Convention of the American Foundrymen's Society. First half appeared in June.

Steel

High Temperature Impact Properties of Cast Steel, C. F. Christopher, Continental Foundry & Machine Co., Chicago. Investigation showed that brittleness is a common characteristic of all steels, and that it depends upon the carbon content and amount of carbon segregation due to selective freezing. The width of the hot tearing zone depends entirely upon the distance between the liquidus and solidus lines of freezing which determines the extent of selective freezing. The elimination or minimizing of hot tearing depends upon pouring temperature, which sets up the stress, and scientific heading, gating and chilling which eliminate or dissipate the stress.

A Metallographic Study of Ruptures in Steel Castings, J. B. Caine, Cincinnati, Ohio. Tensile fractures are ragged and show extensive plastic deformation. Transverse fractures show microscopic shatter cracks ahead of the visible crack which disappear at fracture leaving a ragged surface with plastic deformation. Fatigue fractures are flat, possibly intergranular. Notched impact (brittle) fractures are flat with angular projections. Cooling (quench) cracks, distinguished by location, are sharp, continuous, or a zig-zag acicular, depending on microstructure. Hot tears are discontinuous and associated with ferritic, interdentritic as-cast metal. Intercolumnar shrinkage has scalloped edges on elongated voids (with interdentritic metal also).

What Design Engineers Look for in Castings, Trevor Davidson, Bucyrus-Erie Co., South Milwaukee, Wis. The design engineer is looking for just one thing—the least expensive way to make a part which adequately meets service requirements. The foundry and manufacturer may think of the lowest price delivered to the machine shop. The user thinks the least expensive part is the one which gives him the maximum return on his investment after considering machine movement frequency, reduction in pay load, cost of repair and labor for rapid wear or premature failure, and sometimes the shutdown cost of an elaborate plant while a key machine is out of service (pages 118-122, May issue).

Casting steel in graphite molds was described by H. H. Hursen, Griffin Wheel Co. Seated (left to right): Allan Bixby, National Malleable & Steel Castings Co.; H. F. Bishop, Naval Research Laboratory; T. H. Shartle, Texas Electric Steel Casting Co.

Influence of Molding Materials on Incidence of Hot Tearing, J. M. Middleton, British Steel Castings Research Association, Sheffield, England. The geometry and mass of a 35-lb test casting, and resulting thermal conditions, compared to a 10-lb casting, have little increased effect on the behavior of clay-bonded sands; however, the prolonged time after pouring at which hot tearing occurs, allows a more complete breakdown of organically-bonded sands to take place. High green and dry compressive strength of sand mixes at room temperature affect sand behavior under casting conditions, increasing the incidence of tearing.

Steel Castings—Their Engineering Advantages in Weldments, E. J. Wellauer, Falk Corp., Milwaukee. Casting in sections allows cost to be lower and quality to be higher. Casting appendages and thin walls can be removed from the pattern and cast separately or be made of wrought materials. Casting in sections with resulting higher physicals allows

lower factors of safety and more uses for cast parts in weldments. Minimizing hot tears, easier molding, founding, and cleaning, and more reliable inspection with less value loss in scrap cast components, result from casting in parts.

Hot Tears, Lyle L. Clark, Armour Research Foundation, Chicago. There is no correlation between pouring temperature or pouring rate and tearing. No structure in the torn area could be defined as being influential. Inclusion count testing did not give conclusive information. Variations in chemistry did not appear to affect hot tearing to a noticeable degree. The greatest influence on hot tearing is core hardness; however, deoxidation practice (aluminum vs. non-aluminum) has an apparent effect also.

The Use of Steel Castings by the Southern Pacific Company, B. F. Kline, Southern Pacific Co., Sacramento, Calif. Due to isolation from eastern industrial centers in the early years of western railroading, the Southern Pacific built and operated foundries to a greater extent than usual in American railroad practice. Materials are frequently qualified at distant sources on the basis of tests witnessed at the factory by the representative of some other railroad. Inherent characteristics of design and material make steel casting construction cheap and effective to repair.

Manufacture of High-Quality, Pressure-Tight Steel Castings, J. F. Wallace, Case Institute of Technology, Cleveland. Pressure-tight, high-strength castings can be produced in static sand molds economically when the melt is closely controlled, the casting sound, crack-free, clean, and of fine-grained steel through-hardened by quenching, and tempered to the required strength level. Optimum combination of tensile and toughness properties were attained with a chromium-nickel-molybdenum composition, the relative amounts of which are determined by the section size which must be hardened throughout.

Ladle Practice, Arthur P. Guidi, Texas Electric Steel Casting Co., Houston, Texas. The author described procedures and materials used in lining ladles at his plant. Newly lined, 1 and 5-ton bottom pour ladles are heated at 600-800 F for 6-10 hr, then at about 1600 F for 2-3 hr. Sidewalls need no patching for about 30 heats; new nozzles and some bottom patches are installed after each heat. 3½-ton teapot ladles, with monolithic lining, are dried at about 600 F for 12-15 hr, then heated at about 1600 F another 2-3 hr. No patching should be necessary for 10-12 heats; a new bottom is put in every 15-20 heats to assure slag-free operation; and the spout is relined every 20-30 heats, regardless of its condition.

Development of a Bottom Pour Ladle Practice for Quality Steel Castings, A. W. Fastabend, American Steel Foundries, East Chicago, Ind. Quality castings, safety, economy, and higher pouring temperatures resulted from this study of steel ladle practice. See the April issue of AMERICAN FOUNDRYMAN, pages 43-45.

Factors that Contribute to the Production of Clean Castings, C. B. Williams, Massillon Steel Casting Co., Massillon, Ohio. Thorough mixing of alloys added at the time the 3-ton teapot ladle is filled is assured by pouring part of the heat into a 1500-lb ladle then back again. Slag in the teapot spout is removed in this operation, thus allowing each heat to be poured out to a 50-75-lb heel instead of 150-200-lb heel, even though slag does enter the spout in doing so. Double pouring fills the mold twice as fast, and minimizes spalling or pull down. Gating systems of all large castings are made of ceramic tile.

A Simplified Method for Determining Riser Dimensions, H. F. Bishop, E. T. Myskowski, and W. S. Pellini, Naval Research Laboratory, Washington, D. C. A simple index based on the ratio of length plus width divided by thickness is related empirically to riser volume expressed as a fraction of the known casting volume. This procedure involves cal-

Above . . Heat Transfer Symposium was dedicated to the late H. A. Schwartz by W. K. Bock, National Malleable & Steel Castings Co., who pointed out that Dr. Schwartz had been devoted to a search for foundry fundamentals.

Above . . AFS President Frank J. Dost presents checks and certificates to top Apprentice Contest winners (l. to r.): Richard T. Bernier, steel molding; Frederick S. Moran, gray iron molding; Chester Boersma, non-ferrous molding; Gene Boll, wood patternmaking; Wm. J. Cook, metal patternmaking.

Left . . Head table at the Gray Iron Luncheon had (seated l. to r.): J. S. Vanick, International Nickel Co.; C. F. Walton, Gray Iron Founders' Society; J. E. Foster, AFS technical assistant; W. H. Johnson, Naval Research Laboratory; C. K. Donoho; American Cast Iron Pipe Co. Standing (l. to r.): Wm. G. Ferrell, Auto Specialties Mfg. Co.; AFS Vice-President F. W. Shipley, Caterpillar Tractor Co.; W. W. Levi, Lynchburg Foundry Co.; H. E. Henderson, Lynchburg Foundry Co.; V. A. Crosby, Climax Molybdenum Co.; J. T. MacKenzie, Acipco.

Refractories speaker Sam Carter, American Cast Iron Pipe Co., had in the front row of his audience (l. to r.): Walter E. Jaeschke, Whiting Corp.; F. W. Jacobs, Texas Foundries, Inc.; and H. E. Henderson, Lynchburg Foundry Co.

culating the index, relating index to riser volume by means of a graph, and finally translating riser volume to diameter and height dimensions.

Application of Chills for the Solidification of Rib and Boss Hot Spots on Plates, H. F. Bishop and E. T. Myskowski, Naval Research Laboratory, Washington, D. C. Thin appendages (ribs or bosses) act as cooling fins and create a chilling effect at their junction with the parent plate. Thick appendages create a hot spot at the appendage-parent plate junction which results in gross shrinkage, the severity of which is proportional to the width and depth of the appendage. A chart was presented which indicated the chill thickness required to neutralize the effects of appendages.

Pressure Pouring and Graphite Permanent Molds Used in Production of Steel Car Wheels, H. H. Hursen, Griffin Wheel Co., Chicago. Graphite molds were adopted to eliminate sand, sand defects, and cleaning problems. A system of applying compressed air to force molten steel through a refractory tube up into the bottom of the mold cavity was devised to overcome severe mold erosion and splashing during conventional pouring. Pouring rate of 150 lb per sec is accomplished by increasing air pressure ½ lb per sec; metal flows quickly and quietly and is under control at all times. Sand is used only in insulating sleeves for three risers on each wheel.

Sand

General Motors Experimental Foundry, L. J. Pedicini, Process Development Section, General Motors Corp., Detroit. The largest producer and consumer of ferrous castings in the world recently completed experimental foundry facilities at the corporation's technical center. An area of 120 ft x 240 ft is planned to permit casting on a simulated production basis of any ferrous casting up to the eight cylinder engine block. Jobbing shop facilities permit casting parts up to two tons. Aluminum castings up to 300 lb and copper-base alloy castings up to 500 lb can also be produced. See May AMERICAN FOUNDRYMAN, pages 110-117.

What Are Your Raw Material Costs? S. C. Massari, Hansell-Elcock Co., Chicago. The actual cost of a material must include, in addition to the vendor's invoice price, the cost of handling within the plant. Material can frequently be shipped in another form or type which can be more easily handled; often without changes in the plant or additional handling equipment. While outside engineering assistance may be desirable in preparing detailed plants and cost estimates, the original concept and overall plans should originate from plant supervisory personnel.

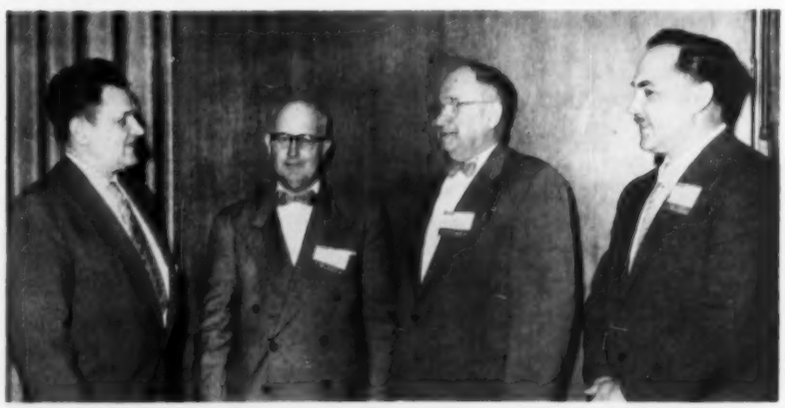
Steel Foundry Sands at Elevated Temperatures, H. W. Meyer, General Steel Castings Corp., Granite City, Ill. Because each foundry has its own base sand, sand handling facilities, sand preparation, core making, mold making, gating, risering, melting, and pouring practices, and its own conception of sand control; the foundryman employing analytical thinking of research work rather than duplication of recommended sand mixes will derive the greatest help from research reports. This progress report of the AFS Sand Division Committee (8-L) Physical Properties of Steel Foundry Sands at Elevated Temperatures says that western bentonite is the most effective of five clays in increasing hot deformation.

The Scabbing Defect, R. L. Doelman, Miller & Co., Chicago. Unaccommodated expansion (U.E.) is the excess of hot expansion over hot deformation as determined by dilatometer; the greater the difference, the thicker the layer of sand subjected to destructive stresses. U.E. can be used to forecast the size and probable type of scab that the sand will produce. A sand with hot expansion much lower than hot deformation at all temperatures would have a high safety factor in preventing scabs. The Scabbing Defect is a progress report of The AFS Sand Division Committee (8-J) Physical Properties of Iron Molding Materials at Elevated Temperatures.

A New Foundry Sand Core Binder, Charles J. Gogek, George M. Moffet Research Laboratories, Corn Products Refining Co., Argo, Ill. The new binder is a white, water-soluble powder containing over 90 per cent of corn sugar, commonly called dextrose. The remainder is a catalyst which converts the dextrose into a resin-like substance during baking. A basic core mix, sand, water, cereal binder (for green strength), and dextrose binder (for baked strength), suitably formulated and prepared, possesses all the properties required to form green cores by the usual methods.

It Is Not All Sand! C. A. Sanders, American Colloid Co., Chicago, and Nathan Levinsohn, Minneapolis-Moline Co., Minneapolis. On too many occasions a molding sand mixture, a molding sand practice, or molding sand control is given full blame for certain unrelated casting defects. Slag inclusions, mold shift, short pouring, cope reversing, crushing, interrupted pouring, insufficient clamping, early shakeout, cold metal are among non-sand conditions giving rise to scrap castings.

Current Status of Test Patterns for Evaluation of Sand Mixtures, Charles Locke. In securing information about the design and function of test patterns from literature and foundry experts, it was found that every test pattern since 1924 is written about in the TRANSACTIONS of the AMERICAN FOUNDRYMEN'S SOCIETY. A complete list of references is provided. The various patterns are summarized as to description, purpose, sand properties measured, sand properties correlated, results, metal used, and photograph. This is a prog-



Pattern Luncheon featured (left to right): R. L. Olson, Dike-O-Seal, Inc.; J. W. Costello, American Hoist & Derrick Co.; A. F. Pfeiffer, Allis-Chalmers Mfg. Co.; and John F. Roth, Cleveland Standard Pattern Works.

Looking for hidden costs at the Industrial Engineering Round Table Luncheon are (l. to r.): Wallace E. Boswell, Glamorgan Pipe & Foundry Co.; M. E. Annich, American Brake Shoe Co.; M. T. Sell, Sterling Foundry Co.

Molding sand properties he shoots for are pointed out by Thomas C. Alford, Wheland Co. (second from right). Others (left to right) are: Harry Wilson III, Electron Corp.; F. E. Kurtz, Electric Steel Castings Co.; F. W. Jacobs, Texas Foundries, Inc.; Herbert F. Scobie, editor, Modern Castings; and Frank S. Brewster, Brumley-Donaldson Corp.

ress report of continuing work of the AFS Sand Division Committee (8-T) Standard Test Patterns.

Casting Finish—a Function of Sand Additives, Burdette Jones, John Deere Waterloo Tractor Works, Waterloo, Iowa. Probably the most simple sand mix is the best one as each additional ingredient increases the variables. Generally, when one factor is improved, others are adversely affected. When experimenting, avoid the gradual approach, try what you think would be an excess and, if it is, then decrease to determine the optimum amount to use. A gradual approach from the low side takes considerable time and you never know the most favorable condition until it has been exceeded (this issue, pages 80-84).

Load-Carrying Power of Molding Sands, Harry W. Dietert and Alexander Graham, Harry W. Dietert Co., Detroit, and F. S. Brewster, Brumley-Donaldson Co., Los Angeles. The movement of sand as load is applied by the weight of molten metal may be sufficient to enlarge the mold cavity to and cause internal porosity or shrinks. Stress-strain curves of molding sands show precisely how a sand behaves under load.

A sand is resistant to loading as long as increments of load are accompanied by equal increments of deformation, and a sand should never be used outside this straight-line relationship.

Engineering Methods in Practical Sand Problems: Strength-Density Relationships, V. E. Zang and G. J. Grott, Unitcast Corp., Toledo, Ohio. It is concluded from tensile and compressive strengths, and from shear values that simple stress calculations are applicable to molding sand mixtures. This allows the separate evaluation of bond strength and coefficient of intergranular friction at any given density of the mixture. The density beyond which additional compaction will be of little value, and which may be susceptible to expansion defects can be accurately determined. The ratio of bond strength to friction accurately reflects the moldability of sand mixtures.

Microscopy and Molding Sands, V. D. Frechette, New York State College of Ceramics, Alfred University, Alfred. The polarizing microscope together with the stereoscopic microscope have already contributed largely to the understanding of foundry mold materials, to their development, and to their control in use. Recent trends toward extensive mechanization of sand handling and molding systems place increasing demands on reliability and performance of materials. The microscope will be used to improve compositions, guard specification, and trouble-shoot unhealthy process trends.

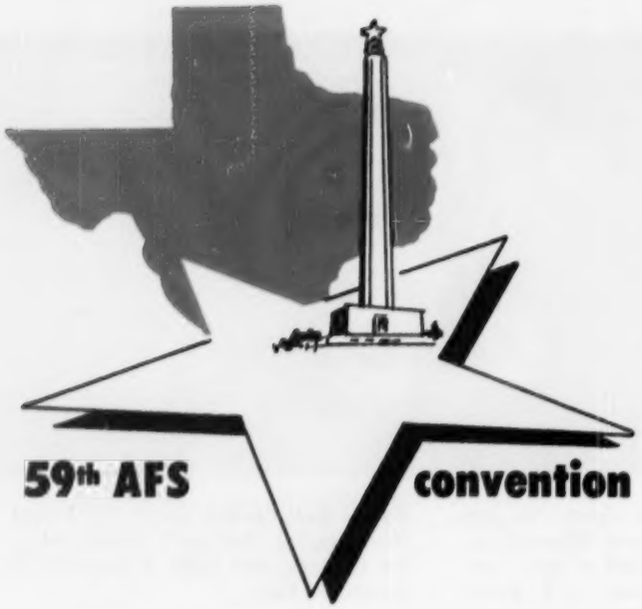
Coreroom Practice Pitfalls, R. H. Greenlee, Auto Specialties Mfg. Co., St. Joseph, Mich. The core should be produced to facilitate quality casting rather than to overcome certain coreroom problems. Dependable sources of quality raw materials must be established. Core mixtures with minimum raw materials should be determined and maintained. Core evaluation should be with respect to the effect on the casting rather than the core itself. A day to day core scrap program should be instituted.

A Critical Analysis of the Cylindrical Standard Test Specimen for Foundry Sands, Walter Goetz, George Fischer, Ltd., Schaffhausen, Switzerland. To illustrate the individual effects of moisture and density, as well as the air space volume on permeability and strength, the author developed a ternary diagram. It was discovered that constant permeability was possible with decreasing air volumes. Patterns of strength and permeability curves were shown as a function of moisture content and, in effect, the result of the particular compaction method used in making the test specimens.

Reactions During Core Baking, G. J. Grott, Unitcast Corp., Toledo, Ohio, and H. F. Taylor, Massachusetts Institute of Technology, Cambridge. It is of utmost importance that adequate circulation of air be provided to sweep away water and other by-products of the core baking process. Although the peak tensile strength was unchanged, increased oven humidity delayed the attainment of peak strength approximately 75 per cent. The source of drying oils (linseed, soybean, corn, etc.) does not affect the rate of drying as long as the same proportion of linolenic, linoleic, and oleic acids is maintained.

Clay, Fines, and Water Relationships for Green Strength in Molding Sands, A. H. Zrimsek and R. W. Heine, University of Wisconsin, Madison. It appears that the sand grains, silica fines, and finally the clay are the principal materials accounting for most of the water required for tempering molding sands. The green strength of sand-clay mixtures is sensitive to clay content below 10 per cent southern and western bentonite, and below 20 per cent fireclay and silica flour. Above these percentages a strength equal to that of the clay substance itself prevails.

Principles of Agglomerating Processes, Carl Ludwig, Bonnot Co., Canton, Ohio. The size distribution of crushed materials is in accord with normal repacking habits; however, when particle sizes are lost, size distribution is not the optimum for agglomeration. Lack of microsize fractions and predominance of uniform sizes are the most frequent faults. The strength of an agglomerate is evidenced in the structure of any stone wall which owes its stability to the mechanical interlock of larger rocks effectively wedged by the smaller ones. Be it rocks or colloidal



particles, regardless of scale, the cumulative effect of the mechanical locks between particles determines the stability and endurance of the mass.

Gray Iron

Oxygen Content of Gray Cast Iron Increases with Time, R. C. Williams and H. W. Lownie, Jr., Battelle Memorial Institute, Columbus, Ohio. Gray cast iron can absorb oxygen when stored under average atmospheric conditions; vacuum fusion analyses for oxygen should be made as soon as possible after the iron is cast. The mechanism of absorption is not known; but it is possible that the increase in oxygen occurs as a result of (1) some form of oxidation in the areas around the graphite flakes connected to the surface or (2) oxygen adsorption on the graphite flakes.

Dissolved Gas in Liquid Cast Iron, Wm. Y. Buchanan, John Lang & Sons, Ltd., Johnstone, Renfrewshire, Scotland. Moisture is the cause of most gas formation in cast iron; considerable gas is picked up from a wet ladle even when no bubbling in the metal is noticeable. Gas escaping rapidly through metal may delay freezing locally. Low fluidity of high-duty irons makes gas content more serious. The volume of gas found in iron treated with soda ash is greater than in the untreated metal; the addition of mill scale to soda ash appears to effect the desired degasification.

Calcium Carbide Desulphurization by the Injection Process, John A. DeHuff, Air Reduction Research Laboratories, Murray Hill, N. J., and R. Schneidewind, University of Michigan, Ann Arbor. The injection of calcium carbide into cast irons by means of a carrier gas is an easy, clean method of desulphurizing. The reaction is quite rapid, and so is the rate at which waste products clear a 500-lb bath. Microstructures of desulphurized samples show an increase in matrix ferrite and a trend towards fine, compacted, type-D graphite at low sulphur values.

Increasing Carbon Content of Cast Irons by Ladle Injection. G. E. Spangler, Air Reduction Research Laboratories, Murray Hill, N. J., and R. Schneidewind, University of Michigan, Ann Arbor. Substantial and uniform increases in carbon can be attained from heat to heat by injection periods consistent with foundry production procedures. This method of carbon control outside the cupola permits the use of one base iron composition which can be altered at will by injection in the ladle to suit any particular casting. Calcium carbide can be injected simultaneously with carbon if it is desired to desulphurize at the same time. Greater uniformity and predictability of properties are possible by carbon injection.

Plant & Plant Equipment session discussion is held by (seated l. to r.): H. W. Johnson, Wells Mfg. Co., and James Thomson, Continental Foundry & Machine Co. Standing (l. to r.) are: H. C. Weimer, Beardsley & Piper Div., Pettibone Mulliken Corp.; and James Sutherland and C. O. Schopp, Link-Belt Co.

New High Strength Cast Irons Produced by Injection Methods, J. W. Estes, Air Reduction Research Laboratories, Murray Hill, N. J., and R. Schneidewind, University of Michigan, Ann Arbor. Injections of calcium carbide and rare-earth oxides (with and without magnesium oxide) can produce upgraded cast irons with as-cast tensile strengths of about 50,000 psi and above. These irons can be considered intermediate between gray iron and nodular iron, having certain advantages over each. Outstanding properties of upgraded irons are ductility and high strength, insensitivity to cooling rate in various sections, low hardness, machinability, low chill depth, and low solidification shrinkage.

Fluidization-Injection Process for Desulphurizing and Upgrading Cast Iron, G. P. Dahm, H. C. Barnes, and C. E. Bieniosek, Development Laboratory, Linde Air Products Co., Div. of Union Carbide and Carbon Corp., Newark, N. J. Although it is not a cure-all, the injection desulphurization process provides a substantial stride forward for foundries producing specialty castings, high strength castings, or products to meet rigid physical and chemical specifications. The process reduces the necessity for premium cupola charge materials. Producers of nodular iron are given improved production control and a cleaner finished product with considerable savings in costs.

Machinability Testing — Relation Between Cutting Temperature and Tool Life for Gray Irons, E. A. Loria, formerly with Carborundum Co., Niagara Falls, N. Y., and D. R. Walker, Massachusetts Institute of Technology, Cambridge. No difference was found between the temperature of surface cuts and succeeding cuts, perhaps because, even on the first cut, most of the material removed can be considered subsurface. Force and temperature measurements in cutting are generally more reproducible than wear measurements and may prove to be of value in acceptance testing and quality control of cast irons.

Developments in the Light Castings Industry Including the New Die Pressing Process, R. S. M. Jeffery, Federated Foundries, Ltd., Manchester, England. After telling of developments in improved working conditions, grinding dust control, cupola emission control, enamel blistering, and mechanization, the

author describes an outgrowth of post-war casting demands and manpower shortages—a mechanized permanent mold process for producing low-cost, gray as-cast iron parts. See pages 88-95, May AMERICAN FOUNDRYMAN.

Theory of Nodular Graphite Formation in Ductile Cast Iron, Paul H. Anderson, South Dakota School of Mines and Technology, Rapid City. On the basis of evidence presented it seems reasonable that the nodular graphite forms in the undercooled melt as a result of precipitation of a cloud of minute carbon platelets which subsequently coalesce as an intermediate phase. This phase then permits crystal growth to occur from the graphite-metal interface toward the center of the nodule in the same manner that metal solidifies in the vicinity of the mold wall.

Nickel Austenitic Ductile Irons, F. G. Sefing, International Nickel Co., Inc., New York. The most widely useful of nickel austenitic ductile irons, 2% Cr-20% Ni-1% Mn alloy offers excellent service possibilities where resistance to corrosion, metal-to-metal wear, and heat applications involving erosion of salts, wet steam, and corrosive slurries are encountered. Its good castability has already been utilized in replacing some of the corrosion-resisting alloys more difficult to handle in the foundry.

Risering of Nodular Iron, R. C. Shnay and S. L. Gertsman, Dept. of Mines and Technical Surveys, Ottawa, Ont. Variations in silicon content from 2.57 per cent to 3.13 per cent do not have any appreciable effect on the feeding distance of hypereutectic nodular irons. Hypoeutectic nodular iron plates ½-1½ in. thick have a shorter feeding distance than hypereutectic plates of equal thickness.

Welcoming (left to right) General Manager Wm. W. Maloney and President Frank J. Dost to the AFS Ladies' Tea are Mrs. Jake Dee, Mrs. James R. Hewitt, Mrs. Dost, Mrs. Bruce L. Simpson, Mrs. Frank W. Shipley, and Mrs. Maloney.

Non-Destructive Testing Symposium speakers were (left to right): Joe W. Beckham, Texas Foundries, Inc.; Francis H. Hohn, Scullin Steel Co.; W. D. Kiehle, Eastman Kodak Co.; Kermit Skeie, Magnaflux Corp.; Hans J. Heine, AFS technical director; A. W. Gilbert, Carbide & Carbon Chemical Co., Houston Section chairman, Society for Non-Destructive Testing; Jewelle N. Ketchbaw, Industrial Welding & Testing Laboratory; and Kenneth G. Roberts, Naval Research Establishment of Canada. Symposium will appear later in MODERN CASTINGS.

Officers and trustees at the Foundry Educational Foundation luncheon were E. J. Walsh, executive director; Earl Paltenghi, H. C. Macauley Foundry Co.; C. V. Nass, Beardsley & Piper; E. R. Oeschger, General Electric Co.; James H. Smith, General Motors Corp., vice-president; Thomas Kaveny, Jr., Herman Pneumatic Machine Co., past president; L. H. Durdin, Dixie Bronze Co.; H. A. White, Smeeth-Harwood Co.; F. X. Bujold, Ford Motor Co.; Charles H. Martin, M & H Valve & Fittings Co.; and R. L. Gilmore, Superior Steel & Malleable Castings Co.

Risering of Gray Iron Castings, E. J. Sullivan, Jr., C. M. Adams, Jr., and H. F. Taylor, Massachusetts Institute of Technology, Cambridge. Primary shrinkage is a function of carbon equivalent, but total shrinkage depends more heavily upon total carbon content. The measured effect of silicon on total shrinkage is less than that predicted theoretically. Shrinkage is related to the structure as well as the amount of graphite thus high sulphur or phosphorus irons with a finely dispersed graphite structure have less shrinkage than irons with coarse graphite.

Risering of Ductile Cast Iron—Riser Dimensions, Feeding Distance, and Other Data, R. A. Flinn and W. A. Spindler, University of Michigan, Ann Arbor, and D. J. Reese, International Nickel Co., Inc., Bayonne, N. J. Centerline shrinkage away from the riser cannot, in general, be corrected by an increase in riser size. This type of shrinkage results from an inadequate thermal gradient from the riser to distant zones. The shrinkage zone is walled off by the rest of the casting from ample liquid metal in the riser. See April AMERICAN FOUNDRYMAN, pages 62-66.

continued on following page

Dudes at the Texas Chapter barbecue are (left to right): L. N. Shannon, Stockham Valves & Fittings, past international president; Miss Lenore Shartle; Thomas H. Shartle, Texas Electric Steel Casting Co.; Mrs. Shannon; Mrs. Shartle; Wm. W. Maloney, AFS general Manager; Mrs. Maloney.

Patterns

Sealing Metal Core Boxes Against Blow-By, Richard L. Olson, Dike-o-Seal, Inc., Chicago. A new synthetic elastomeric material specially compounded to resist steam, alkali, fuel oils, etc., can be bonded to one half the metal core box around the cavity, with an adhesion beyond the strength of the seal itself. A groove machined into the other half receives the seal when halves are booked and prevents blow-by. Continuous type seals have been installed in three and four-part boxes with complete elimination of blow-by. See AMERICAN FOUNDRYMAN, May, pages 101-103.

Gypsum Cement Molds for Plastic Patterns, M. K. Young, United States Gypsum Co., Chicago. Gypsum cements are accurate, dimensionally stable, and adaptable to virtually any mold size and shape. Molds of a thickness greater than 1½-2½ in. are wasting material, are often too heavy to handle, and require a longer time to dry in the oven. The simplest method of making a mold is by pouring. Where compound contours are to be reproduced in plastic the splash-cast technique is used to make plaster molds. This method is also used for large molds, over 4 ft in dimensions and weighing over 200 lb.

Research in the Patternmaking Industry, David T. Kindt, Kindt-Collins Co., Cleveland. Standards are needed in the adaption of plastics to the pattern industry. Recent improved pattern coatings are to be preferred for many jobs. Standards should be set up for pattern glues. Impregnated wood is a dimensionally stable pattern material that is almost as hard as aluminum.

Wood Pattern Construction Standards and Specifications, John F. Roth, Cleveland Standard Pattern Works, Inc., Cleveland. Author proposes that "first class wood patterns" be all patterns with high or permanent production requirements and be made of pine or hardwood as specified by customer; "second class wood patterns" be those for a limited production; and "third class wood patterns," those of which only one casting is to be made, pine lumber and wax fillets being adequate.

Precision Patterns from Zircon Molds, J. E. Stock and A. V. Schoville, John Deere Waterloo Tractor Works, Waterloo, Iowa. For 2½ years all production patterns rammed by slingers or jolt-rollover machines have been made by casting them of gray iron to precision tolerances in zircon sand molds. Any foundry can produce their own production patterns by this method and realize great savings in pattern making time. The cope section of a differential spider pattern required 200 hours finishing time made the conventional ways as compared to 26 hours when precision cast. See April issue, AMERICAN FOUNDRYMAN, pages 34-37.

High Pressure Molding, T. E. Barlow, Eastern Clay Products Dept. of International Minerals & Chemical Corp., Chicago. There are installations for diaphragm molding in which no changes of equipment or patterns have been made while in some cases of pressure molding, completely new patterns have been required .Some foundrymen have not considered the cost of patterns and others are not aware that special patterns are not needed for the diaphragm process. All molding is done on cope and drag mounts because high machine speeds makes the use of match plates inefficient; in addition, match plates are not rigid under high pressures. The principal problem in patternmaking for the process is accuracy equal to the desired precision.

Heat Transfer

Range of Effectiveness of Chills, Victor Paschkis, Columbia University Heat and Mass Flow Analyzer Laboratory, New York. The influence of the chill decreases gradually from its center to its edge and into the casting until a point is reached where the metal solidifies as though no chill were present. If only surface conditions are important, almost any chill thickness will do; the influence of the chill does not extend substantially beyond its edge.

Feeding Range in Shell Molds, R. E. Morey, H. F. Bishop, and W. S. Pellini, Naval Research Laboratory, Washington, D. C. The feeding ranges in ½-1½ in. thick shell molded plates of alloys exhibiting centerline shrinkage are: steel, ½T; manganese bronze, 5½T; nodular iron (CE = 4.2), 6½T; and (CE = 3.6), 6T; where T = plate thickness. Gray iron can be fed for essentially semi-infinite distances. Aluminum-7% silicon, aluminum-4% copper, and G bronze develop uniformly distributed porosity irrespective of casting length. Feeding range data obtained for conventional sand molds are applicable to the case of shell molds.

Risering Requirements of Nodular Iron, R. C. Shnay, Dept of Mines and Technical Surveys, Ottawa, Ont. Although thermal properties of nodular iron are much the same as gray iron, risering requirements are much greater. The formation and growth of free graphite produces an expansion during solidification of both metals; however, in gray iron this expansion can be taken up by movement of the liquid metal. This self-feeding characteristic of gray iron does not exist in nodular, which may require larger risers than the same casting in steel.

Application of Indirect Chills, Charles Locke, formerly with West Michigan Steel Foundry Co., Muskegon, Mich. The indirect chill does not make actual contact with the casting surface. Chills are separated from the casting surface by coating them with a core wash. Varying the number of dips with drying between, permitted control of insulation thickness from 1/32 to 3/16 in. The correct thickness of coating was determined by trial and error. Indirect chills afford a means of combating hot tears while allowing for sufficient feeding to take place.

Risering of Commercial Steel Castings, Charles W. Briggs, Steel Founders' Society, Cleveland. For a fast estimate of the size of riser that will solidify after the casting, 20 per cent is added to the diameter of a riser that will solidify at the same time as the casting; as taken from a graph of solidification times for various riser sizes and various plate sizes. This approximation gives the planner a quick approach to riser layout. Normally the person handling risering will apply the practical and safe rule of making the riser height about 1½ times its diameter.

Application of Insufficient Chills, E. C. Troy, Riverton, N. J. Chills, 15-40 per cent of sufficiency, were used to control solidification of a staggered, semi-plate, steel test casting. The riser at one end of each casting was larger than the calculated minimum size, but in accord

Traditional AFS Past Presidents Breakfast was attended by (clockwise starting left): L. N. Shannon (1940-41), Walter L. Seelbach (1951-52), Collins L. Carter (1953-54), Herbert S. Simpson (1940-41), Dan M. Avey (1934-35-36), Robert E. Kennedy, AFS secretary emeritus, I. R. Wagner (1952-53), Ralph J. Teetor (1944-45), W. B. Wallis (1948-49), Fred J. Walls (1945-46), and H. Bornstein (1937-38).

with practice when a single commercial casting is to be produced. The casting without chills had extensive shrinkage in all staggared sections; whereas the chilled casting was free from shrinkage in all sections.

Non-Destructive Testing

A Valuable Tool for the Foundryman, Hans J. Heine, AFS technical director. Non-destructive proof of existence of a flaw does not in itself express the influence of the undesirable condition upon strength or ultimate serviceability of the part. There is a serious lack of specific information on the influence of defective conditions. Data must be developed by comparing test coupons and components free from flaws with those containing known defective conditions under operating conditions or by means of destructive tests. Establishment of arbitrary standards on the basis of fear rather than sound knowledge results in loss of millions of dollars worth of finished parts. Intelligently used, non-destructive testing is an invaluable, economical tool in the hands of a trained engineer or technician.

Increased Foundry Profits Through Non-Destructive Testing, Kermit Skeie, Magnaflux Corp., Chicago. Production costs, which must take into account come proportion of defective castings, can be reduced by developing preferred production techniques with the aid of non-destructive test methods. These tests should not be used only for segregation of defective parts. Cost of non-destructive testing is small compared with production cost savings, and testing costs can be reduced by means of automation.

Improving Casting Quality Through Non-Destructive Testing, Francis H. Hohn, Scullin Steel Co., St. Louis. Radiographic and magnetic powder equipment are used to obtain quantitative information about steel casting quality which is then used to evaluate factors that might be responsible for deviations from desired soundness levels. Soundness was related to FeO content of slag in one case, to tap temperature in another. (May, pp. 96-100.)

Experimental Stress Analysis, Joe W. Beckham, Texas Foundries, Inc., Lufkin, Texas. Design program based on exerimental stress analysis can be started with equipment costing only $1500—a brittle lacquer kit, a strain indicator, and assorted power rams and fixtures. Properly designed castings developed often result in a lighter casting, minimum scrap, maximum yield in production.

Use of Cobalt 60 for Castings, Jewelle N. Ketchbaw, Industrial Welding & Testing Laboratory, Houston, Texas. Co-60 is inexpensive, permits short source-film distance, has adequate sensitivity over a wide range of object thickness. Sensitivity of 1 per cent or better is possible. Foundries can set up their own facilities for reasonable cost or can use commercial laboratory if need arises only infrequently.

Practical Methods of Attaining Constant Sensitivity and Density in Industrial Radiography, Kenneth G. Roberts, Naval Research Establishment of Canada, Halifax, Nova Scotia. With 250 kv portable x-ray machine and Co-60, film density of 2.5-3.0 and penetrameter (flat rather than step type) on source side of specimen give best assurance of casting quality. Unsharpness is kept to a maximum of 0.005 in. by adjusting source-film distance; voltage rather than exposure time is adjusted in accord with specimen thickness.

Use of Radiography in the Non-Destructive Testing of Castings, W. D. Kiehle, Eastman Kodak Co., Rochester, N. Y. Radiography gives a "complete picture" of a casting, and enables the foundryman to guarantee soundness, reduce losses. It helps develop foundry techniques by showing when and how changes in production procedure have taken effect.

Refractories

Improving Refractory Cost in Malleable Melting, L. E. Emery, Marion Malleable Iron Works Div., Chicago Railway Equipment Co., Marion, Ind. The use of 9 x 6¾ x 3-in. No. 1x wedge in bottoms reduced joints and decreased the rate of vitrification. Lack of metal fins between the joints reduced conduction of heat and bottom temperatures. Combustion control and the use of secondary air at the burner reduced erosion at the tap out section and improved sidewall and bottom life to a point where no repair is made to the furnace during the firing life of the furnace. Complete repair of forehearth, sidewalls, bottom, and bungs has been reduced to 0.24 man hours per ton of metal melted.

A Malleable Furnace Refractory Cost Reduction Program, Fred J. Pfarr and Albert S. Johnson, Lake City Malleable Co., Cleveland. A new method of sidewall construction resulted in a saving, over a one-year period, of five man-hours of repair labor per heat and 172 nine-inch equivalents of refractory bricks per heat. Actual savings totaled over $30 per heat regardless of tonnage melted. With proper planning and supervision, existing practices can be methodically bettered.

Forehearth Refractories for Soda Ash Desulphurizing, Sam F. Carter and Ralph Carlson, American Cast Iron Pipe Co., Birmingham, Ala. No material was found, regardless of form or composition, that was completely resistant to soda slags. The longest single runs of 8 to 16 days on the same forehearth were obtained from linings of low porosity clay brick, a special mortar, and very tight joints. The mortar and fitting technique can over-shadow material variables. The principal advantage of clay plastics, which lasted up to 5 days, was their low cost of application and ease of patching.

High-Duty, Super-Duty, and High-Alumina Refractories in the Foundry, F. H. Fanning, Harbison-Walker Refractories Co., Pittsburgh, Pa. Power pressed bricks have the best over-all physical properties and the widest range of applications. Avoid large intricate shapes. For best over-all economy use standard arch brick, for example, instead of special door arch shapes. Standard shapes also have improved physical properties. Compare the cost of installing standard vs. special shapes.

Monolithic Converter Linings, J. Davies, Messrs. Davies & Baird

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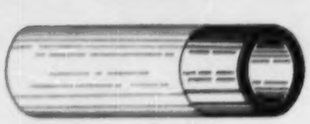
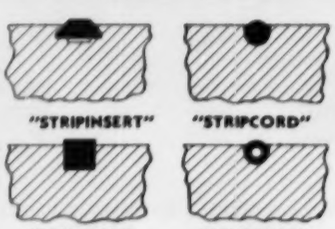
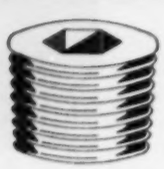


"SAND ARRESTER TUBE"
Blows perfect core without hand work; prevents bell mouth blow holes; saves cores, castings and time.

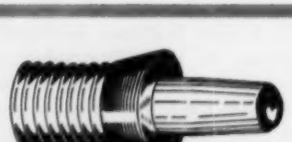


Hold Parting Line

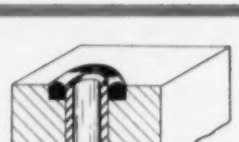


"HOLINER" BUSHINGS
Seals around blow holes at the junction of blow plate and core box.

"PULLINSERT"
Stops abrasion under blow holes. Needs no adhesive, is easily replaced.



"PROTEXABOX" PIN
Can't mar box parting, never vibrate loose, prevent pin lug damage.



"D RING" COLLARS
Seal around the top of blow tubes, vent rods and guide pins.

"SUPER SLICK"
Core room and foundry hand tool. Use to scrape, pry, chisel and pull nails. A new one free if you return one broken.

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For more facts, circle No. 106 on page 103 or 104

Pty. Ltd., Melbourne, Australia. A rammed monolithic lining composed of bentonite and crushed quartz is vastly superior to a silica brick lining. One of the secrets of success is hard ramming of about 1½-in. of the loose material at a time between the former and the backing-brick lined converter shell. The longest run of 354 heats was accomplished with a 4½-in. lining of quartz graded for maximum density, and involved the average consumption of 40.5 lb lining material (including patching) per ton of steel.

Banners Depict Safety

A giant-size accident prevention banner, 10 ft long by 3½ ft deep and printed in two brilliant colors, has been added to the National Safety Council's stock of safety training aids. The banners come in indoor and outdoor models, both made of heavy duck, with the latter specially weatherproofed and vented and having full length ropes stitched in top and bottom for secure fastening. Both styles are the same size and are printed in signboard inks.

A new idea in safety training aids is offered in the N.S.C. "banner-a-month" plan. This simply means that on an annual subscription basis you can have a new banner shipped by the fifteenth of the month preceding its scheduled use—one for each month of the year.

For a flyer showing miniatures of many of the banners in full color, and for information on prices contact the National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill.

Aid For Design Engineers

Alloy Casting Institute, Mineola, N. Y., has published *"A Selection Guide to Corrosion-Resistant Cast Alloys,"* an article prepared to aid design engineers in the use of cast stainless alloys.

Defining the various corrosion-resistant cast alloy grades and their general fields of application, this guide should help the design engineer to select the most suitable cast alloy for both corrosion resistance and mechanical requirements. Complete details on mechanical, physical and fabricating characteristics of the stainless alloys are presented in numerous charts and tables. Copies may be obtained by writing to Alloy Casting Institute, Mineola, N. Y.

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obituaries

Carl F. Mayer, president and founder, Carl Mayer Corp., Cleveland, passed away recently. He was a graduate of the University of Michigan in 1918, after which he spent a year with the United States Shipping Board. He then served as an engineer with Ohio Body & Blower Co., Cleveland, and after three years became associated with Swartwout Co. there, as manager of its oven division. He was named vice-president of Foundry Equipment Co., Cleveland, in 1930, and four years later became treasurer of the Smith-Mayer Corp. Two years later this became Carl Mayer Corp., with Mr. Mayer as president and treasurer. He was a recipient of the Trinks Industrial Heating Award for 1953 for notable contributions to economic and scientific progress in industrial heating.

Charles McLeod Lewis, 61, president of Badger Malleable & Mfg. Co., died recently after a long illness. He became president of Badger Malleable in 1949, after the retirement of A. J. Ricker who, with Harry M. Lewis, father of C. M. Lewis, had founded the business in 1908. After the death of his father in 1938, Mr. Lewis served as secretary-treasurer. He graduated from the University of Wisconsin in 1916, after which he went on to receive his master's degree in metallurgy. He was a member of the Wisconsin Chapter of American Foundrymen's Society and a past director of the Malleable Founders' Society.

Gustaf A. Lillieqvist, 61, research director, American Steel Foundries, Chicago, died suddenly of a heart attack on May 31. He had been very active in the metallurgy of cast steel and had devised numerous alloys and deoxidation practices.

Mr. Lillieqvist attended Polytechnical Institute of Zurich and the University of Berne, Switzerland, receiving his Ph.D. in Chemistry in 1924 from the latter. He was born in London, England, coming to the

Continued from page 113

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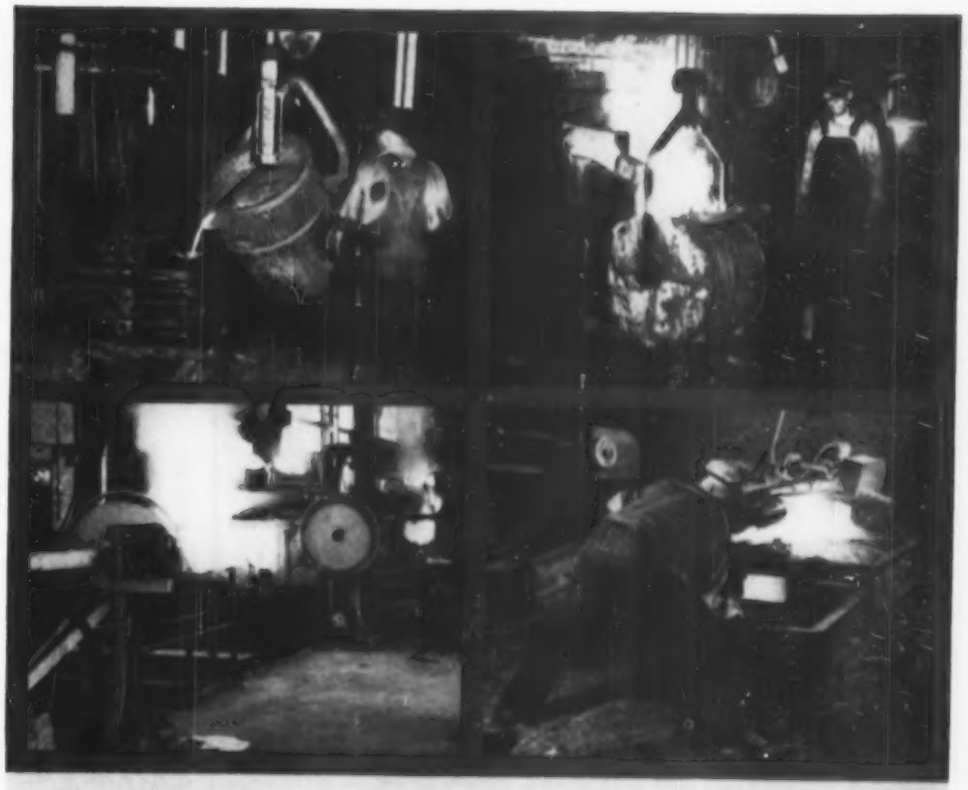

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chapter news

St. Louis

The final meeting for the season of the St. Louis Chapter was held on May 12. Apprentice Training Chairman Dale Arnette, Arnette Pattern Co., introduced Eugene Boll, Central Pattern Co., as the 1st place winner in national competition in the wood patternmaking division.

The following officers were elected for the coming year: *Chairman,* George L. Mitsch, A.C.F. Industries; *Vice-Chairman,* John O'Meara, Banner Iron Works; *Treasurer,* R. C. Kane, Midvale Mining and Mfg. Co.; *Secretary,* Paul E. Retzlaff, Nordberg Mfg. Co. Directors to serve for three years were elected as follows: Jack H. Thompson, East St. Louis Castings Co.; R. E. Hard, St. Louis Coke & Foundry Supply Co.; Ralph Peterson, Central Pattern Co.; F. J. Boeneker, Bronze Alloys Co.

The annual chapter picnic was announced for Saturday, August 6th.

Guest speaker for the meeting was L. G. Probst, National Engineering Co., Chicago, who spoke on *"Reducing Costs by Practical Mechanization."* The only reason for mechanization is to reduce costs and is defined as providing methods of servicing the molder so as to make the greatest number of molds at the lowest cost. Sand mechanization is divided into four parts and should be studied separately as follows (1) Shakeout (2) Processing sand and castings (3) Reworking (4) Mold handling. Before mechanization is started, it is important to make a careful study of the existing operations and then to start in a small way at the proper place, he pointed out. Advantages offered were (1) Improved molding material (2) Reduced manpower (3) Lower scrap. Pitfalls to be encoun-

HAROLD WHEELER, ALLYNE-RYAN FOUNDRY CO.

Northeastern Ohio . . Present at the April meeting, from left to right, Regional Vice-President, E. C. Hoenicke, Eaton Mfg. Co., Vassar, Mich.; immediate National Past President Frank J. Dost, Sterling Foundry Co., Wellington, Ohio; Chapter Chairman David Clark, Jr., Forest City Foundries; and National Director Frank C. Cech, Cleveland Trade School, Cleveland.

E. H. MOSSNER

Saginaw Valley . . From left to right at the May meeting, Carl Tobias, General Motors Institute, technical chairman for the iron group meeting; Donald E. Mathieu, Kerchner, Marshall & Co., guest speaker at the meeting; Warren D. Lewis, Great Lakes Foundry Sand Co., guest speaker at the steel group meeting; Woodrow Holden, chapter chairman; Arthur W. F. Green Allison Div., G.M.C., guest speaker at the light metals meeting, and Warren L. Larson, Dow Chemical Co., technical chairman for the light metals group meeting.

tered are (1) Difficulty of selling supervision and workers (2) Trying to start too fast (3) Lack of flexibility.

The speaker showed slides of several existing installations and then conducted a question and answer period.—*Jack Bodine.*

Central Michigan

The May meeting was held at the Hart Hotel, Battle Creek, Mich. J. Secor, Hill & Griffith was technical chairman and guest speaker was Harry Kessler. Mr. Kessler's subject was *"Economics of Good Foundry Operation."*

Gardner Lloyd, Albion Malleable Iron Co., was elected chapter chairman for the coming year and was presented the foundry gavel by retiring chairman Lachlan Currie, Gale Mfg. Co.—*L. Heisler.*

Central Illinois

Lester B. Knight, Lester B. Knight Associates, Inc., Chicago, was guest speaker at the May meeting in Peoria, Ill. His subject was *"Modernization of Foundries,"* and he was introduced by William L. Messmore, Wagner Malleable, Decatur, Ill., technical chairman for the evening. Burton Bevis, chapter chairman, presided.

Mr. Knight explained to the group the type of organization that was needed to make automation successful and pointed out the problems they

Eastern Canada . . Presentation of the Past Chairman's Pin to Claude Bourassa, fourth from right, by new Chapter Chairman Wm. Dunn, third from the right, was made at the May meeting. Others standing from left to right are: P. von Colditz, W. Tibbits and K. Scanlon. Seated, left to right, J. Kinsella, M. McQuiggan, H. Robb and J. Dick. Meeting was held at Mount Royal Hotel, Montreal, Quebec.

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must cope with. A number of slides were shown of successful applications of automation.

Newly elected officers for the coming year were: *Chairman*, R. Hieden; *Vice-Chairman*, K. Smith; *Secretary-Treasurer*, J. Kauzlarich, and *Directors*, S. Roby, F. Seegar and B. Bevis.—*C. Turner.*

Twin City

It was Old Timers' Night at the May meeting of the chapter. Thirty-six men from the Twin City area with over 45 years of service to the foundry industry were honored. Of these "old timers," 25 attended the meeting as guests of the chapter. Cast bronze ash trays commemorating the occasion were awarded to each.

John R. Roth, Progress Pattern & Foundry Co., St. Paul, Minn., donated the castings and E. S. Reiland, General Pattern Co., St. Paul, prepared the pattern. Finishing touches were done at the Archer-Daniels-Midland Co., Research Laboratories, Minneapolis.

Guest speaker was C. Arps, Allis-Chalmers Mfg. Co., Milwaukee, and his subject was *"Our Most Valuable Asset."* He pointed out that good public relations has its origin within the company itself and hinges on three main points which are controlled by the company. These points are: management's policies toward the employees and business ethics, the public relations organization within the company, and the willingness of the employees to cooperate with management. This latter point is, to a large extent, governed by the first two. The speaker concluded with the thought that it was the intention of public relations efforts to convince the public that business is human and has a heart.—*R. J. Mulligan.*

Washington

The May meeting was held at the Block House, between Seattle and Tacoma, Wash. Thirty-eight members and guests were present to hear Martin J. O'Brien, Jr., Atlas Foundry & Machine Co., Tacoma, Wash., speak on *"Steel Casting Design."*

A short Directors' Meeting was held in conjunction with the technical session to discuss program scheduling for the coming year. Two new directors were elected to fill vacancies: J. Uren, Firebrick Supply Co., and M. Uebel, Eagle Foundry Co. Directors F. Young, E. A. Wilcox Co., and V. Rowe, Ballard Pattern & Brass Co., were elected secretary and treasurer, respectively.

In his paper, Mr. O'Brien stressed three points which the foundryman acts upon to improve quality and thus profit. These points are: (1) Simplicity of design gives better load carrying abilities. (2) The poorest casting produced is the one which the industry as a whole is judged by. (3) Castings can be sold on their own merit, i.e., there are many instances where castings are far superior to other types of production.

The first move towards improvement is to educate design engineers with castings and problems of the casting industry. The design engineer is responsible for the ultimate properties such as service life, quality, cost of manufacture, homogenity and failure in service due to the method, shape and material of construction.

Eastern Canada

The May, and final meeting of the year, was held at the Mount Royal Hotel, Montreal. Chairman C. Bourassa presided.

New officers and directors for the coming term were elected as follows: *Chairman*, Wm. C. H. Dunn, Western Pattern Works; *Vice-Chairman*, M. McQuiggan, La Salle Coke Co.; *Secretary*, L. Myrand, Montreal Foundry Co., and *Treasurer*, M. Pascal, Crane, Ltd.

Directors: J. H. Bertrand, Canadian Car & Foundry Co.; C. Gouin, Dominion Brake Shoe Co.; N. Kitchen, Canadian Ingersol-Rand; A. Lewis, Dominion Engineering Works, and W. Nuttal, Warken King.

Local apprentice contest winners were presented with certificates and prizes at the meeting.—*P. von Colditz.*

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Twin City.. Some of the thirty "old-timers" attending the May 10 Twin City Chapter meeting honoring those men with 45 years service in the foundry industry.

St. Louis . . Eugene Boll, Central Pattern Co., right, receiving congratulations from Apprentice Chairman Dale Arnette, Arnette Pattern Co., upon winning first place in the AFS national competition in wood patternmaking at the May meeting.

Eastern New York

An "Off the Cuff" talk on sand control and testing by Cliff Apgar, Adirondac Foundries, was the feature of the May meeting held at Panetta's Restaurant, Menands, N. Y. More than 50 members and guests heard Mr. Apgar relate some of his experiences with sand control in iron, steel and non-ferrous foundries over the past 30 years. He said one of the big problems in this field is that often when one defect is eliminated, by controlling some variable in the sand mix, another one is introduced. Therefore, the foundryman must carefully balance the properties of his mold and core mixes.—*L. J. DiNuzzo.*

Mo-Kan

A. J. Van Harn, Grindle Corp., was guest speaker at the May meeting. His subject was *"Dust, Fumes and Smoke Control in the Foundry Industry."*

Officers elected for the coming year were: *Chairman,* H. Deterding, Sonken Glamba; *Vice-Chairman,* E. Hayden, Neville Foundry Co.; *Secretary,* H. Julian, Blue Valley Foundry Co., and *Treasurer,* H. Schwickrath, Prier Brass Mfg. Co.

Board members elected were: W. Collins, Superior Brass Aluminum Co.; T. Shadwick, Witte Engine Works; L. Graper, Fairbanks Morse Co.; G. Williams, Williams Pattern Works, and retiring Chairman L. Canfield, Canfield Foundry Supply & Equipment Co.

AFS National Director J. T. Westwood, Jr., was present and he commented on the Missouri Valley Regional Conference, scheduled for September 29-30 at Rolla, Mo.—*H. Julian.*

Mexico City

At the April meeting the following officers and directors for the coming term were elected: *President,* Ing. Urbano Lopez Ayala; *Vice-President,* Ing. F. Serdaneta; *Secretary-Treasurer,* Ing. Luis Delgado Vega. Directors: Ing. Esteban Fuchs, Sr. Miguel Chapa and Ing. Teodoro Albarran.—*N. S. Covacevich.*

Philadelphia

The May meeting was held at the Engineers Club, Philadelphia, with approximately 125 members and guests in attendance.

New officers for the coming term were installed at the meeting. They were: *Chairman,* Charles Mooney, Jr., Olney Foundry, Link-Belt Co., Philadelphia; *Vice-Chairman,* Walter Giele, Walter Giele Co., Lebanon, Pa.; continuing as *Secretary-Treasurer,* Wm. B. Coleman, Wm. B. Coleman Co., Philadelphia, and *Assistant Secretary-Treasurer,* Merman Mandel, Pennsylvania Foundry Supply & Sand Co.

Joseph J. Schil, apprentice at Dodge Steel Co., Philadelphia, who won third place in the National Apprentice Contest for steel molders, was presented an award.

AFS Regional Director H. Gordon Robertson was a guest at the meeting.

Guest speaker at the meeting was Raymond C. Huntoon, Pressure Match Plate Co., Inc. He gave an interesting talk and showed a film on *"Manufacture of Pressure Match Plates,"* and the *"Production of Patterns by the Plaster Process Method."*

Technical chairman for the evening was Earl Eastburn, Philadelphia Brass & Bronze Co.—*C. R. Sweeny.*

Quad-City

After a short business meeting which included election of officers and the annual treasurer's report, Chapter Chairman W. Ellison, Theim Products, turned the May meeting over to M. Horton, Deere & Co., who acted as Panel Moderator.

"Casting Finish," the subject of the first panel, was discussed by T. Burkland, Deere & Co.; R. Potter, I. H. Farwall Works, and R. Groves, Red Jacket.

The conditions and type of work each panel member is involved in was described before Casting Finish was mentioned. Mr. Burkland stated that lower grain fineness sands were being used with resin bonded sands with little difference in finish.

Mr. Potter announced the effect of hydrostatic pressure on finish of green sand castings. Mr. Horton interjected that high green permeability was a controlling factor when considering the effect of hydrostatic

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Chicago . . J. H. Jackson, Battelle Memorial Institute, guest speaker.

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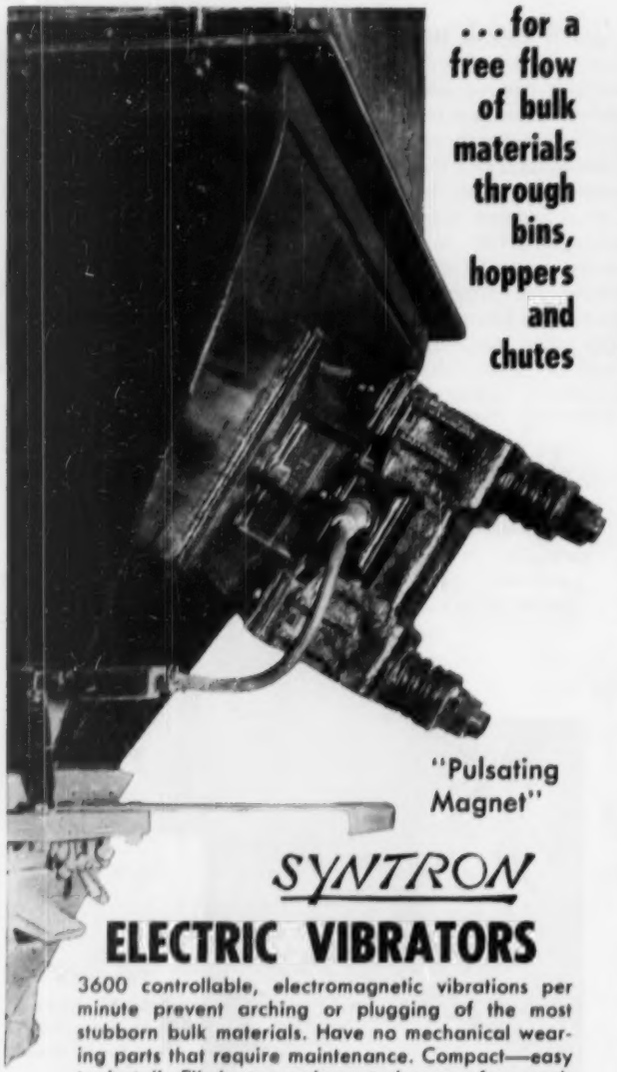

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LEO HOUSER, DODGE STEEL CO.

Washington . . Martin J. O'Brien, Atlas Foundry & Machine Co., speaking at the Washington May meeting.

pressure. Mr. Groves, also in green sand work, emphasized the effectiveness of mold spray in heavy work.

The second panel, *"Core Sand,"* consisted of C. Humphrey, J. I. Case, Rosk Island Works; R. Miller, John Deere Planter Works, and A. DeConnick, Walworth Foundry Co. Mr. DeConnick astounded many by describing his method of standing up six in. T-cores and the abandonment of all driers by the use of high green strength core sand blown at high pressure, 125-135 psi.—*G. F. Thomas.*

Western Michigan

The May meeting was held at Bill Stern's Restaurant, Muskegon Heights, Mich. Victor M. Rowell, Harry W. Dietert Co., Detroit, was guest speaker and his subject was *"Sand Practice."—Wilson W. Hicks.*

Philadelphia . . Joseph J. Zohil, apprentice at Dodge Steel Co., left, who placed third in the National contest for apprentice molders, receiving his award from Daniel Best, Bethlehem Steel Co., chapter chairman.

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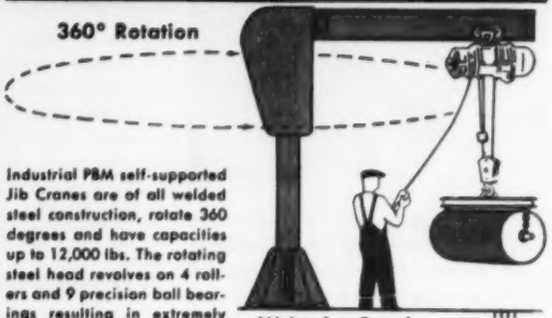

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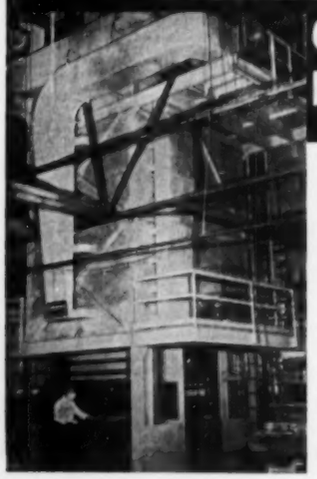

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Western Michigan . . Chapter Chairman elect, George Bartlett, Neway Equipment Co., Muskegon, Mich., left, receiving gavel from retiring chairman John A. VanHaver, Sealed Power Corp.

Southern California

More than 100 members and guests attended the May meeting held at the Rodger Young Auditorium.

New officers elected for the coming term were announced as follows: *President,* William Baud, Mechanical Foundries Div.; *Vice-President,* William Mitchell, Utility Steel Foundry; *Secretary,* Frank Warga, AiResearch Mfg. Co., and *Treasurer,* Otto H. Rosentreter, Otto H. Rosentreter Co.

A brief resume of the progress made to date on the local educational program was given by Edward Haines, H. Kramer & Co. The report indicated that a sound foundation has been laid for an aggressive educational program.

Speaker for the evening was William D. Emmett, Los Angeles Steel Casting Co. His subject was *"Control of Used Sand by pH."—W. G. Stenberg.*

Northeastern Ohio

About 300 members and guests attended the May meeting at the Tudor Arms Hotel, Cleveland, to honor past presidents and old-timers. David Clark, Jr., Forest City Foundries, chapter chairman, presided only long enough to make several announcements before turning the meeting over to Walter L. Seelbach, Superior Foundry, Inc., who served as chairman for the remainder of the program.

Nearly 100 old-timers attended and were seated in separate groups at tables according to the number of years they had served in the industry. Past presidents of the chapter awarded certificates to the qualified old-timers. Old-timers present represented 4675 years of service to the foundry industry.

Ben Fuller, 91, was made honorary chairman of the Old-Timers Club.

S. E. Kelly, Eberhard Mfg. Div., Eastern Malleable Iron Co., immediate past chapter chairman, presented the outgoing chairman, David Clark, Jr., with a plaque in recognition of his service to the chapter.

It was announced officially that the chapter had succeeded in its long-time goal of becoming the No. 1 chapter, membership-wise, in the AFS. The Chicago Chapter relinquished the honor.

Newly elected officers for the 1955-56 season are: *Chairman,* Lewis T. Crosby, Sterling Wheelbarrow Co.; *Vice-Chairman,* Alexander D. Barczak, Superior Foundry, Inc.; *Second Vice-Chairman,* E. Claude Jeter, Ford Motor Co.; *Secretary,* Howard E. Heyl, Federal Foundry Supply Co., and *Treasurer,* Harold Strater, North American Refractories Co.

Directors elected for three years were: Walter H. Siebert, Cleveland Standard Pattern Works; Norman J. Stickney, Sand Products Co.; Robert H. Herrmann, *Foundry,* A. H. Hinton, Aluminum Co. of America, and Fred S. Green, Elyria Foundry Div., Industrial Brownhoist Co.

J. H. Tressler, Hickman, Williams & Co., was elected to fill the unexpired directorship of the late Arthur H. Harlan. David Clark, Jr., chapter chairman, was elected to the board for one year.—*Kenneth L. Mountain.*

Saginaw Valley

The April meeting held in Frankenmuth, Mich., and attended by approximately 130 members and guests, was divided into three groups, iron, steel and light metals.

Donald E. Matthieu, Kerchner, Marshall & Co., was guest speaker at the iron group meeting and his subject was *"Cupola Bed Practice."* He detailed the methods of coke selection, preparation of bed and methods of lighting the bed. He recommended coke size one eighth the diameter of the cupola for best results in most cupolas and cautioned that proper preparation and burning-

University of Illinois . . John Nieman, Shell Process, Inc., Peoria, Ill., right, exhibiting castings to students Harry Shulz and P. J. Crean, left to right, following his lecture to the Materials Casting classes at Urbana, Ill.

KEN SHECKLER, CALMO ENGINEERING CO.

Southern California . . Attending the May meeting from left to right, R. Gregg, R. Payne and Myron Niesley.

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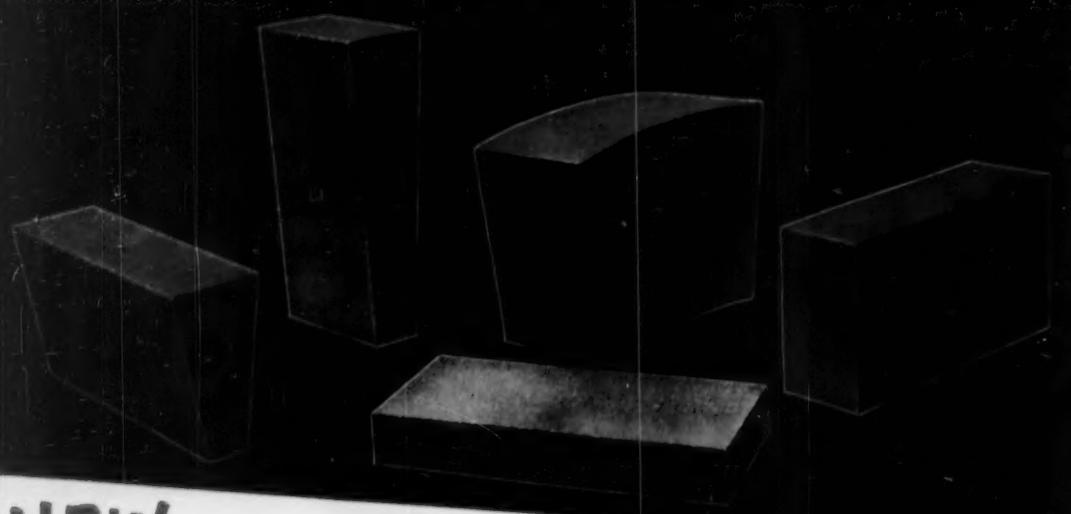

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Central Michigan . . Attending the May meeting from left to right, Gardner Lloyd, Albion Malleable Iron Co.; Jack Secor, Hill & Griffith Co.; Harry Kessler, Sorbro-Mat Process Engineers; guest speaker; and Lachlan Currie, Gale Mfg. Co., chapter chairman.

in of the coke bed is of the utmost importance and care should be taken to burn the bed properly, even at the risk of a delay in operations.

At the steel meeting Warren D. Lewis, Great Lakes Foundry Sand Co., spoke on *"Sand in the Steel Jobbing Foundry."* He led an informal discussion on steel molding and core sands. Emphasized were tests for steel foundry sands and causes and elimination of defects.

Arthur W. F. Green, Allison Div., G.M.C., spoke on *"Use of Light Metal Castings in Aircraft Applications,"* at the light metals session. He traced the evolution of power plants for aircraft from the reciprocating engine to the turbo-prop engine. He indicated that each pound of weight saved reduced the costs greatly and increased the payload and/or the range of the aircraft.—*Nicholas Sheptak.*

Connecticut Non-Ferrous

Discussion of AFS Convention Technical Papers was the subject of the May meeting of the Connecticut Non-Ferrous Foundrymen's Association, held at Shuttle-Meadow Country Club, New Britain, Conn. Discussion leader was Stafford W. Chappell, General Dynamics, Groton, Conn.

Papers discussed included: *"Improvement of Pressure Tightness and Tensile Properties of Gun Metal Bronze by Vacuum Degassing,"* by W. H. Johnson, H. F. Bishop, and W. S. Pellini; *"Vapor Holes from Loose Sand Grains in Brass and Bronze Castings,"* by F. Keller and W. B. George; and *"Short-Time Elevated Temperature Properties of Three Copper Base Casting Alloys,"* by J. O. Edwards.—*Frank B. Diana.*

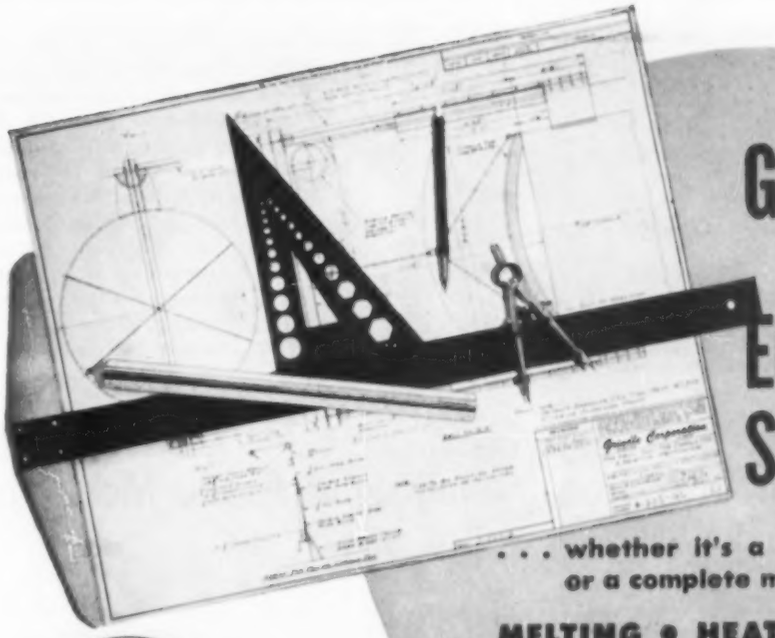
continued from page 105

United States in 1924, and in the same year he was hired as a chemist at the Granite City, Ill., Works of American Steel Foundries. In 1927 he was transferred to the Research Laboratory in East Chicago, Ind., and served there until 1941 when he was appointed assistant works manager and chief metallurgist of the Indiana Harbor Works. In 1943 he became research director for the company.

He has been a member of the Metallurgical Advisory Committee on Cast Armor for the Ordnance Department and a member of the Technical Committee of the Munitions Board. He has served on many committees of the American Foundrymen's Society, Steel Founders' Society of America, American Society for Metals, American Society for Testing Materials, and the American Institute of Mining and Metallurgical Engineers. Among his honors were the R. W. Hunt Award of the American Institute of Mining and Metallurgical Engineers and the Technical & Operating Medal of the Steel Founders' Society.

Leo M. Gartland, president, Atlas Foundry Co., Marion, Ind., passed away recently.

Otis L. Jones, retired president, Illinois Clay Products Co., Joliet, Ill., passed away recently due to a heart and lung complication. He founded Illinois Clay Products Co. and was chairman of the board at the time of his death. Until three months ago, he was the president of the firm and maintained active control of the business. When he stepped down as president, he took on the position of chairman of the board of directors. Mr. Jones founded the company in 1911 at Goose Lake in Grundy County. After graduating from Lewis Institute of Engineering, now the Illinois Technical School, he joined the Harbison-Walker Refractories Co., Pittsburgh, Pa. As a draftsman there, he learned the fundamentals of the clay products business and subsequently became general superintendent of the company at Chester, Pa. It was this firm that sent him to Joliet to supervise the building of the Rockdale refractory plant and to manage it. Seven years after coming to Joliet, he founded Illinois Clay Products.



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Speakers at the G.I.F.S. Michigan-Indiana meeting included (front row, left to right): Eugene Hinze; E. R. White, district director; R. W. Wilder, Northern Indiana Group secretary; F. X. Gartland, Jr., Northern Indiana chariman; and Don C. Moore, Central Indiana secretary. Back row, left to right: G.I.F.S. President C. H. Ker; Donald H. Workman, executive vice-president; Vernon J. Sadler, meeting chairman; and John W. Meyer.

Hold Regional Gray Iron Management Group Meetings

■ Gray iron foundry executives met in California and Michigan during May under the auspices of the Gray Iron Founders' Society to discuss cost of raw materials, labor rates, business conditions, operating rates, and the business outlook.

Over 70 from the Michigan, Northern, and Central Indiana Management and Cost Groups held their first regional meeting May 13 in Marshall, Mich., under the general chairmanship of Vernon J. Sadler, General Foundry & Mfg. Co., Flint, Mich. Eugene Hinze, E. T. Runge & Associates, Cleveland, regional cost consultant for the three groups, presented cost comparisons and led a cost discussion.

A round table discussion of materials and operating costs was led by F. X. Gartland, Jr., Atlas Foundry Co., Marion, and John W. Meyer, Interstate Foundry Co., Indianapolis, chairmen, respectively, of the Northern Indiana Group and the Central Indiana Group. Analysis of labor-management problems was presented by Lee Shaw, Seyforth, Shaw & Fairweather, Chicago.

At the California regional meeting, 86 gray iron foundry executives and their ladies met in Santa Barbara, April 29-May 1. Represented were 33 foundries from both northern and southern parts of the state. G.I.F.S. President C. H. Ker, Dalton Foundries, Warsaw, Ind., and Executive Vice-President D. H. Workman, both of whom subsequently participated in the Michigan-Indiana regional meeting, attended the three-day California sessions.

Hosts were the southern group of foundrymen under the chairmanship of Charles Gregg, Gregg Iron Foundry, El Monte, Calif.

In discussing future plans for regional gatherings, A. H. Renfrow, Renfrow Foundry, Los Angeles, stressed the need for better understanding and exchange of information leading to improvement of products and services of gray iron foundries.

California foundrymen are expected to do their share in supporting the Foundry Educational Foundation program at the University of California (Berkeley), Earl Paltenghi, H. C. Macaulay Foundry, Berkeley, explained in pointing out that the school had recently been added to the group of F.E.F. schools.

West Coast air pollution problems were reviewed in a discussion led by A. D. Sanchez, Vulcan Foundry, Oakland; Gerald Nash, Quality Foundry, Los Angeles; and Charles Bradley, Dayton Foundry, Hollydale. Climaxing the session was an address by Leo Harris, former assistant prosecutor of Los Angeles County.

Current employment practices and problems, and the possibility of some form of credit information service, were discussed by J. E. Barrett, Federal Burner Co., Torrance.

Rundown on current industry statistics and business trends was given by Mr. Workman. He urged the group to make fuller use of G.I.F.S. services and publications. He pointed out that buyers and designers of castings are hungry for authentic business and technical literature. Put the information in the hands of buyers yourselves, he told foundrymen, rather than miss the sales opportunity by letting the G.I.F.S. office do it.

California Group officers (left to right) are: Gordon L. Martin, Northern chairman; D. L. Robertson, Southern secretary; Charles Gregg, Southern chairman; and Earl Paltenghi, organizer and past chairman of the Northern Group.

let's get personal

continued from page 31

Norman L. Deuble has been appointed manager of the newly-created Metallurgical Development Div. of Climax Molybdenum Co., New York. The new division will be responsible for the development and dissemination of technical information pertaining to the use of molybdenum alloy steels in various consumer markets, and molydenum as an alloying material in the steel and foundry industries.

John J. Green has been appointed service engineer in the Pittsburgh office of the Vanadium Corp. of America. Mr. Green comes to Vanadium from Universal-Cyclops Steel Corp., with which he has been associated for the last ten years.

Dr. William J. Harris, Battelle Institute, Columbus, Ohio, named assistant to the director, will headquarter in Battelle's office in Washington, D. C. In his new assignment Dr. Harris will represent Battelle in its relationship with the numerous governmental organizations that sponsor research in the Battelle laboratories.

Ralph D. Parker has been elected vice-president of International Nickel Co. of Canada, Ltd.; **Walter A. McCadden** was elected comptroller.

Norman R. Kidd has been appointed manager of C. O. Bartlett & Snow Company's new Service & Parts Sales Div., Cleveland.

William R. Divine has been appointed vice-president and manager of the Washington, D. C., office of Lester B. Knight & Associates, Inc. **Howard W. Maxon** was appointed vice-president in charge of plant engineering, and **Lincoln J. Karmen** was appointed manager of the New York office.

James C. Black, general manager of the Eastern Reduction Div., Reynolds Metals Co., Louisville, Ky., has been appointed general manager

of the company's Reduction Div. Mr. Black, who has been living at Hot Springs, Ark., will make his headquarters in Richmond. He will have charge of the company's six aluminum reduction plants at Jones Mills and Arkadelphia, Ark.; Troutdale, Ore.; Longview, Wash.; Listerhill, Ala.; and Corpus Christi, Texas.

Howard S. Bunn has been elected executive vice-president and a member of the Executive Committee of Union Carbide & Carbon Corp., New York.

Herbert C. Jackson was elected to the board of directors of Interlake Iron Corp., Cleveland. He is a managing partner of Pickands Mather & Co. and vice-president and secretary of Mather Iron Co., Cleveland.

Tinius Olsen II has been elected president of the Tinius Olsen Testing Machine Co., Willow Grove, Pa. Mr. Olsen succeeds his father, **Thorsten Y. Olsen,** who was elevated to chairman of the board.

C. H. King and **H. D. Ross** have been elected to fill newly-created positions on Clark Equipment Company's board of directors.

C. E. Hawke, engineering pioneer in the development and application of super-refractories for the metallurgical and other industries, has received the Trinks Award, the nation's top honor for achievement in industrial heating. Mr. Hawke is a vice-president of the Carborundum Co., Niagara Falls, N. Y. Two other engineer-executives, selected for their contributions to economic and scientific progress in industrial heating and related fields, were similarly honored. They were **Horace Drever,** president of Drever Co., Bethayres, Pa., and **Walter H. Holcroft,** technical director and executive vice-president of Holcroft & Co., Detroit.

Clarence B. Bergren, formerly manager of the Thor Power Tool Co., Cleveland branch, has been named branch manager at Milwaukee. **Robert J. Grace,** formerly service engineer in the Indiana territory of the Chicago branch, has been appointed to succeed Bergren as Cleveland manager.

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Tell How to Harness Molding Sand Variables

Casting Clinic speakers at sessions held by the Metropolitan Chapter of the American Foundrymen's Society were (left to right): Clyde A. Sanders, American Colloid Co., Chicago; O. Jay Myers, Archer-Daniels-Midland Co., Minneapolis; and Hans J. Heine, AFS technical director. Photo by F. J. Weill, Federated Metals Div., American Smelting & Refining Co.

■ Success or failure in quality castings production may depend on behavior of molding sand mixtures, according to three speakers who presented a Castings Clinic at Newark Central High School, Newark, N. J. Emphasizing principles of molding sand technology, Clyde A. Sanders, American Colloid Co., Chicago, O. Jay Myers, Archer-Daniels-Midland Co., Minneapolis, and Hans J. Heine, AFS technical director, appeared at two evening sessions before the Metropolitan Chapter of the American Foundrymen's Society. The clinic was the second of a series to be held under AFS Technical Dept. auspices at the request of local foundry groups.

Proper preparation of molding sand results in economies in cleaning room and machine shop that are reflected in the profit and loss statement, the clinic brought out. Data and information were presented to enable foundrymen to reduce scrap, increase yield, and reduce production costs.

EDITOR'S NOTE: Some 70 articles and publications recommended to the clinic are available to MODERN CASTINGS readers in the form of a bibliography. This can be obtained by requesting "Foundry Sand Practice Bibliography" from Reader Service, Modern Castings, Golf & Wolf Roads, Des Plaines, Ill.

After reviewing quartz, olivine, and zircon sands, and natural vs. synthetic sands, clinic speakers discussed mixing. They advised making additions by weight, not volume, and gave the following hints for minimizing clay balls: work sand as dry as possible; keep clay and fines as low as possible; reduce riddling and handling to a minimum.

Principal clay mineral used in synthetic sands are kaolinite (chief constituent of fireclays), montmorillonite (chief constituent of bentonite), and illite (found in many clays). Western bentonite develops higher dry strength while southern bentonite gives higher green strength.

Water is an important source of trouble because it influences every property of molding sand except grain fineness. Too much water causes excessive gas evolution, low permeability, high dry and hot strength, low mold hardness, and poor flowability. Bentonite-bonded sands yield best green strength at low moisture.

Carbonaceous additives such as sea coal and pitch are used primarily for peel, not finish. A solid, natural pitch available may be used in quantities of 0.4-0.8 per cent. Figures for sea coal are about 5 per cent, for pitch, up to 2 per cent. Finely ground graphite helps give a better casting finish.

Cellulose additives are used as cushioning materials in synthetic or formulated sands. All increase the amount of temper water required. In formulated sands with little clay, the cushioning material permits expansion of silica grains without mold wall movement.

Fine inorganic additives, especially silica flour, are used to increase green, dry, hot, and retained strength. Permeability and flowability are decreased. Other such additives include olivine flour, fly ash, and alumina flour.

Any rapid and unaccounted for change in properties usually spells trouble, clinic speakers warned in discussing sand properties. This is especially true of permeability, which can

TO OBTAIN HIGH QUALITY CASTINGS

and

determine what factors affect pressure tightness in copper-base alloys

read

MELT QUALITY AND PRESSURE TIGHTNESS OF COPPER-BASE ALLOYS

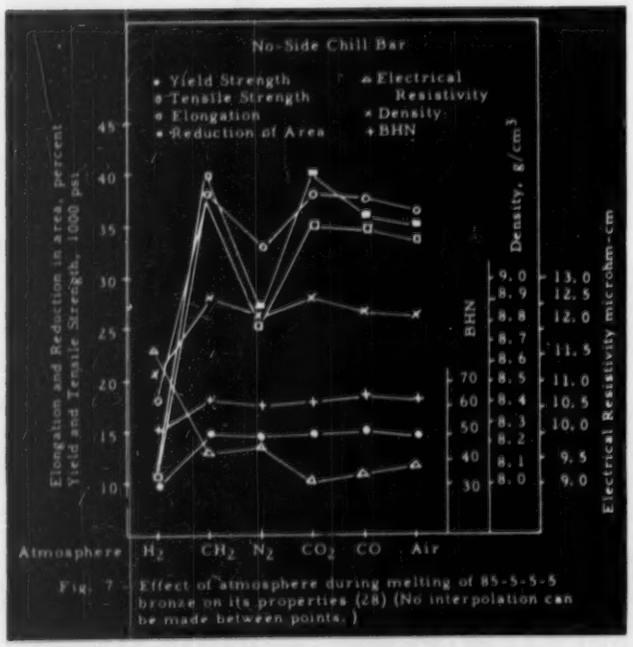

Fig. 7 - Effect of atmosphere during melting of 85-5-5-5 bronze on its properties (28) (No interpolation can be made between points.)

Sponsored at Battelle Memorial Institute under supervision of the AFS Brass and Bronze Division's Research Committee, this survey traces factors affecting melting quality and pressure tightness of copper-base alloys, especially red brass. Causes of unsoundness and methods available to avoid gassing are concisely covered. Suggestions on how to obtain high quality and pressure tight castings are included, as is a list summarizing recommended good foundry practice. This booklet is an invaluable reference for foundrymen and metallurgists engaged in the production of copper-base alloys castings.

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be considered a measure of ventability and casting finish.

Curves plotted for green compression, permeability, mold hardness, and density of specimens rammed one to 10 times gives a good indication of sand mixture quality. Completely dry sand is 100 per cent flowable and any additive reduces the figure. Flowability refers to movement of sand grains under molding forces; deformation indicates the plasticity or amount a body of sand "gives" before it breaks. Deformation and flowability are interdependent.

There is much to learn about hot properties of sand mixtures and while much development work has been done, no standard tests are available. In addition to mechanical properties, mold-metal interface reactions, metal penetration, and heat transfer characteristics need further evaluation.

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Good place to study foundry sand problems is at the shakeout. Not only sand, but also sprues, gates, flasks, etc., tell a story.

Metallograph Contest Set

The Tenth Metallographic Exhibit of the American Society for Metals will be held at the National Metal Congress and Exposition in Philadelphia, Oct. 17-21. A prize of $100 cash will be presented for the best entry in the show, and blue ribbons will be given to the best entry in each of the 12 classifications, with honorable mentions to others.

The subjects include: (1) carbon and alloy steels, (2) stainless steels and heat resisting alloys, (3) cast and wrought iron, (4) aluminum, magnesium, beryllium, titanium and their alloys, (5) copper, nickel, zinc, lead and their alloys, (6) metals and alloys not otherwise classified, (7) micros showing transitions or changes during processing, (8) welds and other joining methods, (9) surface phenomena, (10) results by unconventional techniques (not electron micrographs), (11) slags, inclusions, refractories, and cermets, (12) micographs in color.

For details write: A.S.M. Metallographic Exhibit, 7301 Euclid Ave., Cleveland 3, Ohio.

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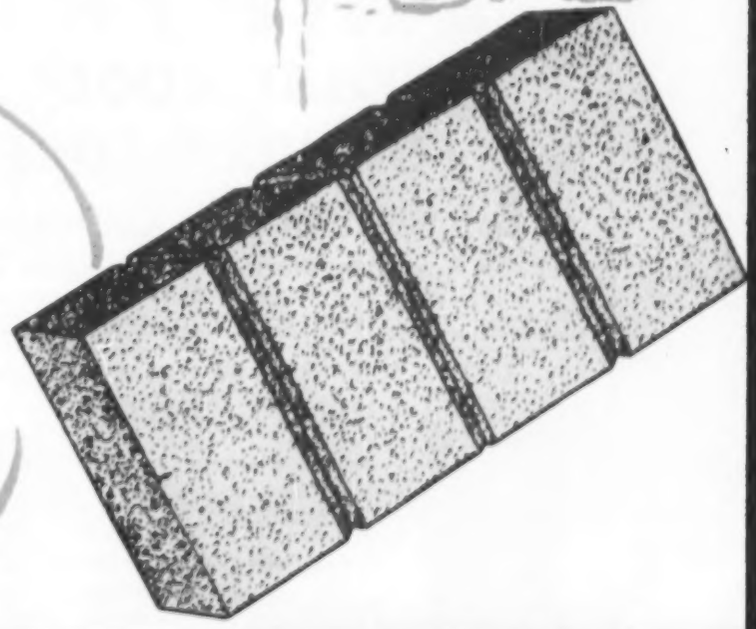

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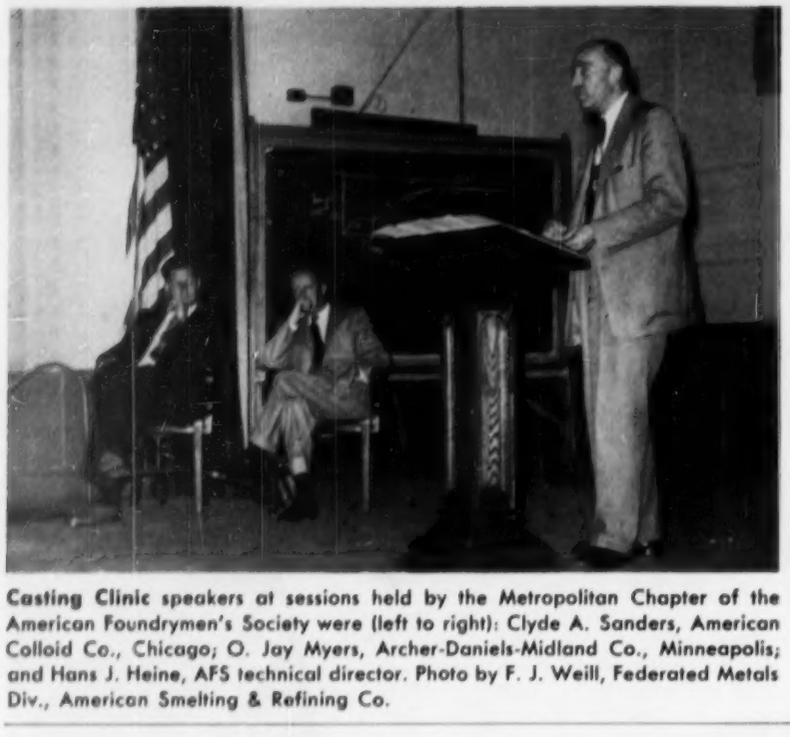

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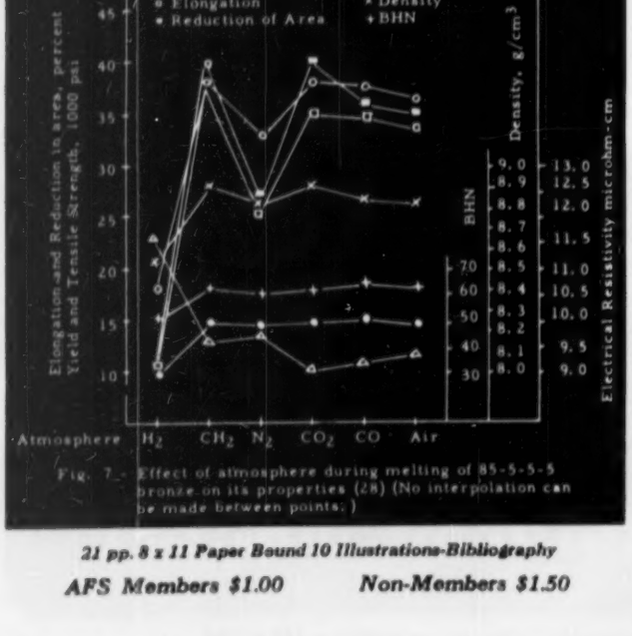

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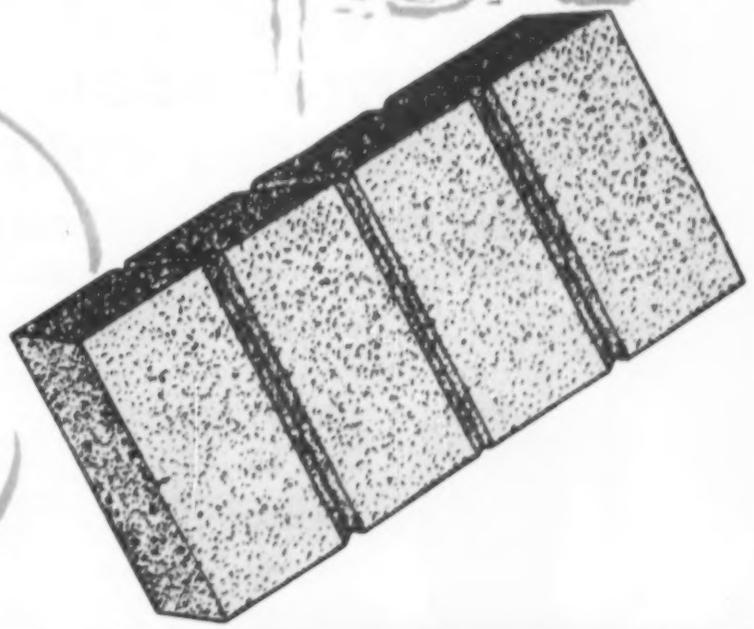

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*T.M. Reg.

DAVID'S GLOVES

DAVID'S GLOVES, INC. SPRINGFIELD, OHIO

For more facts, circle No. 111 on postage-free Reader Service card on p. 103 or 104

3-in-1 Automatic Core and Mold Blower

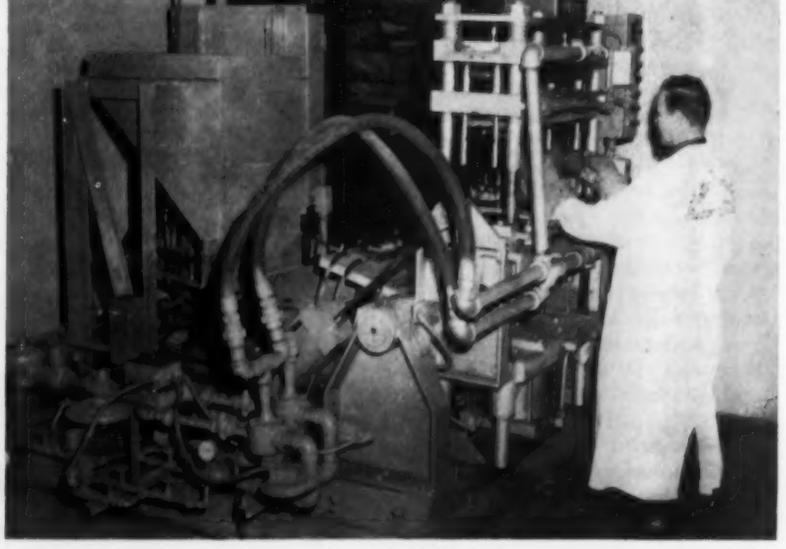
■ A new machine that automatically makes and bakes resin-bonded cores was unveiled by Sutter Products Co., Dearborn, Mich., early in June. The versatile new equipment will handle boxes up to 14 x 24 in. and 7 in. deep to produce hollow or solid cores or shell molds ready to use without further processing at the rate of 50 to 90 cycles per hour. Boxes can be changed in 15 to 20 minutes.

Air operated an dilectrically controlled, the machine goes through its cycle from closing of the empty box, through blowing and baking, to opening for removal of finished cores entirely automatically once the operator has pushed the start button. Cores are baked in boxes heated by radiant-type ceramic gas burners which are thermostatically controlled.

Typical cores produced by the machine include: jacket and intake manifold cores (solid, without wires); steering gear core (shell, about one-third the weight of a solid core); shell mold halves precision backed for stacking or assembling in mechanical lock-ups that eliminate sand or shot backing. All are made with precoated sand mixed in standard mixing equipment.

Simply and ruggedly constructed, the 3-in-1 core and mold machine has only three basic movements: box opens and closes and core is released by stripping pins; rock back for blowing, rock forward; sand magazine travels back and forth from supply bin to blow position. All steps in cycle can be regulated independently.

Triple-duty machine makes solid cores (top and middle right), shell cores (middle left), and shell molds with precision backs (bottom).



Operator removes pair of shell cores from new automatic machine.

foundry trade news

continued from page 93

tion to its plant at Richmond, Ill. This addition will double its manufacturing facilities.

Interlake Iron Corp., Cleveland, Ohio, the nation's largest independent producer of pig iron, announced net sales and other revenues in the first three months of 1955 of $22,147,449, the highest in the company's history.

Bay City Foundry Co., Bay City, Mich., has adopted the trade name of Ferros T to cover a specialized group of alloy iron castings for use in dies, fixtures, machine tools, and machinery where exceptional properties are required.

An early morning fire caused $200,000 damage to two buildings of the **Chicago Malleable Casting Co.,** 1125 W. 120th St., Chicago.

Black Products Co. has opened its West Coast plant and sales office. The address is P. O. Box 396, Fontana, Calif.

Decatur Casting Co., Decatur, Ind., has completed one full year without a lost time accident. This represents a total of 109,360 accident free manhours.

Archer-Daniels-Midland Co., Minneapolis, has announced that its net profits for nine months ending March 31, 1955, after depreciation and all income taxes is $4,574,761.36.

National Lead Co., New York, has published its proceedings at the Annual Stockholders' Meeting and its report of sales and earnings for the first three months of this year.

National Malleable and Steel Castings Co., Cleveland, announced its earnings for the first quarter of 1955 were $394,865.

Duraloy Co., Scottdale, Pa., has been granted an exclusive license for the manufacture and sale of the new alloy known as Thermenol, covering all states east of the Mississippi River; also Minnesota, Iowa, Missouri, Arkansas, and Texas.

CRUCIBLE FURNACES melt all the metal in this well known Eastern Foundry

Seven forced draft coke fired Crucible furnaces. No. 225 and No. 300 Crucibles are used according to quantity of metal desired.

THE PHILADELPHIA BRONZE AND BRASS CORPORATION

PRODUCER of non-ferrous castings, maintains uniform quality and meets specifications by using only Crucible melted metals.

MELTING EQUIPMENT consists of seven stationary coke fired furnaces (illustrated) each of 900 pounds capacity; three tilting Crucible furnaces (illustrated) oil fired, each 1200 pounds capacity and four stationary oil fired furnaces (not illustrated) 450 pounds capacity each.

CRUCIBLE FURNACES here, as in some 3000 other non-ferrous foundries in the United States, demonstrate their superiority in economy, flexibility and adaptability in the production of sound castings with minimum rejections.

WRITE FOR CRUCIBLE MELTERS' HANDBOOK. MAILED FREE

Three tilting Crucible furnaces oil fired, using No. 430 long lipped Crucibles, 1200 pounds capacity each.

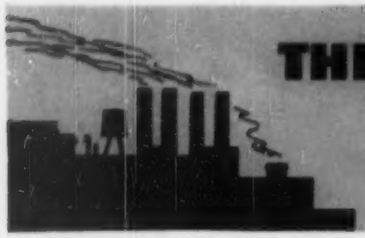
No. 300 Crucibles, 900 pounds capacity, are lifted from the stationary coke fired furnaces carried directly to the molds and poured.

THESE FIRMS CAN TAKE CARE OF ALL YOUR REQUIREMENTS FOR CRUCIBLE MELTING

CRUCIBLE MANUFACTURERS ASSOCIATION
40 EXCHANGE PLACE, NEW YORK 5, N. Y.

Ross-Tacony Crucible Co.
Vesuvius Crucible Co.
Joseph Dixon Crucible Co.
Lava Crucible-Refractories Co.
American Refractories & Crucible Corp.
Electro Refractories & Abrasives Corp.

For more facts, circle No. 114 on postage-free Reader Service card on p. 103 or 104



THE ACME *bargain page*

AIR COMPRESSORS

Chicago Pneumatic 50 HP direct motor driven Type P-4.

BLOWERS

Ingersoll-Rand Motor Blower Type FS. Single Stage 4000CFM @ 3.75 PSI, 100 HP, 220V. G.E. Induction Motor.

General Electric 7500 CFM, 20 oz., 89.6 Max HP, 220V motor, Airway controls.

Ingersoll-Rand turbo compressor 10500 CFM @ 20 oz. 85 HP G.E. 220V 3500 CFM motor.

CLEANING EQUIPMENT

Sly 8' Dia. Table Shot Blast Unit.

Wheelabrator 27" x 36" rubber belt. 36 x 42 Holloway 7½ HP shot motor elevator and dust collector.

CORE BLOWERS

3—International SB 12.

4—International SB 13.

1—International SB 15.

2—Osborn 93.

2—Osborn 193.

1—Osborn 2035-2.

1—Peterson (Similar to Demmler #50).

1—Osborn 5 Station Rotocore Automatic Core Blower. New 1952.

CORE OVENS VERTICAL HORIZONTAL

2—Coleman, combination oil or gas fired 43 carriers 24" x 90"—1 hour 12. min. to 4 hours 48 min. cycle.

1—Coleman, combination oil or gas fired 43—2 shelf carriers 30" x 144" long. 2 hour 12 min. to 7 hour 24 min. cycle. Present replacement cost over $90,000.

CORE ROD STRAIGHTENERS

1—DX5 Kane & Roach ⅛" to ⅝" capacity.

GRINDERS, DISC

1—Gardner 186—36" Vertical Disc Grinder 10 HP motor.

GRINDERS, SNAGGING

5—Hammond 10 W R I Double End Snag. Grinders, 20" dia. wheels, 10 HP 220/440V motors, variable speed drives.

3" x 24" US #65, 20 HP 220/440V.

GRINDERS, SWING FRAME

2—3" x 24" x 12" Fox #4, 15 HP.

1—3" x 24" x 12" Marschke, 20 HP.

1—3" x 24" x 12" U.S., 15 HP.

MOLDING MACHINES

Jolt Squeezers:

13—Milwaukee 103-11 Staty. Jolt Squeezers, 13½" x 20" table.

7—Champion JS10P Portable Jolt Squeeze molding machine, 18" x 21" table.

Jolt Squeeze Pin Lifts BIG ONES:

1—Osborn 724PJ 38" x 56" table, 24" squeeze cylinder 11" jolt cylinder 10" draw.

3—International PK 20's. 20" squeeze cylinder 8" draw. Ser. #67237. New 1949.

1—Osborn 712 PJ. Stationary Jolt Squeeze pin lift 18" x 28" table, 12" squeeze cylinder, 6" draw.

2—Milwaukee Jolt Squeeze Strippers, Model 163-50, 15" x 24" table, 16" x open end pattern size.

1—SPO 214 Jolt Squeeze Pin Lift.

ROLLOVERS—Jolt Rollover Pattern Draw

1—Herman 4000# Series 30" x 60" table, 32" x 48" bumper.

1—Herman 3000# Series 40" x 84" table, special slotted table.

1—Herman 1500# Series 20" x 36" table.

2—Herman 750# Series 20" x 30" table.

2—Herman 750# Series 20" x 24" table.

All the above have air clamps rollout tables.

2—Champion JM-18-8 Jolt rollovers, portable 13½" x 20" tables.

Jolt Pin Lifts:

Johnston & Jennings 1015, 30" x 38" table.

Pin Lift Pushoffs:

2—Champion Pin Pushoffs 28" x 42" table 10" draw.

CASTINGS CONVEYORS OR COOLING TOWER

4580—Jervis B. Webb 678 chain, 6" rail, 1560 trolleys, 4 D-C speed reducer and motor generator set, 3 speed recorders, 400 casting boxes and V shaped baskets, large quantity turns, takeups, etc. This has been used as a single unit but will divide. 75 tons structural steel outdoor tower. 125' long 20' wide 45' high, open steel frame with roof.

MULLERS AND MIXERS

B&P #70 with dust hood and bucket, 100 HP 220/440V motor, starting compensator.

Simpson #3 Motor on Base.

Simpson #3 Type H open gear type.

Simpson #3 Muller with bucket loader.

Simpson #3 Open gear type, $1,000.

Clearfield #404 Muller.

OVENS, MOLD OR CORE

Porbeck Double Car Single door 16' long 14' wide 9' high gas fired 600° recirculating complete with 7½ HP car puller, in place St. Louis, Mo.

Core Oven Electric 68" x 42" high, 65" deep 100°-650°.

POURING DEVICES

13—Pouring devices, Whiting 750# and 1500#.

PREPARATOR

B&P #70 Preparator. Only used 3 months.

SHAKEOUTS

Link Belt 3 x 5.

Simplicity 4 x 6 Heavy Duty 15 HP motor.

SAND SLINGER

B&P Stationary Slinger with bucket elevator to 10' x 10' x 6' sand storage bin, conveyor feeder to double belt head 19" head single speed.

TUMBLING BARREL

1—Whiting double tumbling barrel 36" x 60" Jones reducer 15 HP.

ACME

ACME EQUIPMENT CO., INC.

We will buy for cash a single piece of equipment or your entire foundry

125 South Clinton Street • Phone ANdover 3-3430 • Chicago 6, Illinois

MONA

products and processes

continued from page 12

ordinary bronzes, brasses, nickel and alloy steels. It can also be used for general build-up and fabricating. Descriptive literature, price lists and samples are available on request. *Pacific Welding Alloys Mfg. Co.*

For more facts, circle No. 9 p. 104

Ultrasonic Cleaning

Bendix Ultrasonic Cleaner utilizes the energy of "silent sound" to scrub microscopic but critical contamination from the parts being cleaned. It directs high-frequency sound waves through water-soluble detergents or other solvents surrounding the parts to be cleaned. By forcing cleaning solution to cavitate or "cold-boil," the ultrasonic energy bombards the part from every direction, penetrating the interstices and crevices, scouring out blind holes. Minute implosions caused by the cavitation actually blast loose contamination. *Pioneer-Central Div., Bendix Aviation Corp.*

For more facts, circle No. 10 p. 104

Metal Cutting Torch

Especially designed for light duty work or where air supply is limited, the new model G-2 Arcair torch is the answer to many requests for a low-cost tool incorporating the Arcair principles of operation. Electrodes up to ¼ in. in diameter can be used. Operating characteristics are much the same as the larger model Arcair torches, although the G-2 does not have a separate air control valve. Air is controlled by the angle of the swivel head, and the air is automatically on when the angle of the electrode is set to address the work. The air is automatically cut off when the electrode angle is turned to extreme left, in a non-working position. The air jet is always in perfect alignment with the electrode angle. *Arcair Co.*

For more facts, circle No. 11 p. 104

classified advertising

For Sale, Help Wanted, Personals, Engineering Service, etc., set solid..20c per word, 30 words ($6.00) minimum, prepaid.

Positions Wanted..10c per word, 30 words ($3.00) minimum, prepaid. Box number, care of *American Foundryman*, counts as 10 additional words.

Display Classified . . Based on per-column width, per inch . . 1-time, $15.00; 3-time, $13.50 per insertion; 6-time, $12.50 per insertion; 12-time, $12.00 per insertion; prepaid.

HELP WANTED

AGENTS. To sell replacement wear parts for Sandslingers, parts to fit "Wheelabrator" Shot Blast Equipment, and for similar wear applications. Product group is already established and accepted. Need agents familiar with foundry and metal cleaning industry. Attractive commission arrangement. No inventory. Openings in South and Mid-West. **LATROBE STEEL CO., Special Products Div., Latrobe, Pa.**

PRODUCT MANAGER. Person to handle sales program, set up and assist jobbers, and develop a direct mail and advertising program. Product group includes fine quality replacement wear parts for Shot Blast Equipment, Sandslingers, and other such foundry or metal cleaning equipment. Position involves traveling. Person must be aggressive and proven in sales ability. Desired age 25-40. Write full details to **Box C45, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.** Include a recent photograph.

CLEANING ROOM FOREMAN. Experienced cleaning room foreman for gray iron foundry making small castings. **Box C46, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

PROJECT ENGINEER. Specialized gray iron foundry Mid-Ohio city of about 80,000 population. Various non-repetitive production problems including research and development under supervision of Vice-President. Recent graduate foundry option Industrial Engineer with some shop experience. Replies confidential. Write full details personal background, resume of experience, references and salary expected. **Address Box C43, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

GRINDING FOREMAN. Midwest foundry. State qualifications, references and salary. **Box C44, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

POSITIONS WANTED

METALLURGIST. 8 years non-ferrous refining and jobbing foundry experience in production, quality control and development. Cost and quality conscious. Prefer midwest. **Box C47, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

FOR SALE

FURNACES FOR SALE

10 used Heat Treating Furnaces, and two 7-ton gantry cranes, good condition, priced to sell.

BAER STEEL PRODUCTS, INC.
Box 1425
Boise, Idaho

ENGINEERING SERVICE

EARL E. WOODLIFF,
Foundry Sand Engineer.
Consulting . . . Testing.
14611 Fenkell (5-Mile Rd.) Detroit 27, Mich.
Res. Phone Vermont 5-8724

SESSIONS ENGINEERING CO.
Consulting Foundry Engineers
Modernization, Processing Layouts
Cost Reduction Quality Control
Product — Machine Design
Architectural Design
One North La Salle St. Chicago 2, Ill.

National Founders Visit Congressmen

House Labor Committee members dined with the Administrative Council of the National Foundry Association recently when N.F.A. leaders met in Washington, D. C., to consider labor matters. At the head table (left to right) are: Summerfield Brunk, Headford Bros. & Hitchins Foundry Co.; Congressman Clare E. Hoffman; W. W. C. Ball, Taylor & Fenn Co.; Congresswoman Edith Green; and Paul L. Arnold, U. S. Pipe & Foundry Co. Front row (left to right): J. Boettcher, Harnischfeger Corp.; Albert J. Fruchtl, U. S. Pipe & Foundry Co.; A. Lysle Dyer, Buckeye Foundry Co.; Congressman Sam Coon; and R. R. Washburn, Plainville Casting Co. Second row (left to right): Congressman Harold H. Velde; A. V. Martens, Pekin Foundry & Mfg. Co.; Charles T. Sheehan, N.F.A. executive secretary; H. M. Greenbaum, Acme Foundry Corp.; and L. P. Robinson, Archer-Daniels-Midland Co. Back row (left to right): Wm. J. Bulman, N.F.A.; George A. Euskirchen, Cincinnati Foundry Co.; Erich C. Wussow, Kaukauna Machine Corp.; Lewis N. Essex, Golden Foundry; and Congressman Ralph W. Gwinn. Earlier in the day the Administrative Council met with Senator Wm. Purtell.

Summerfield Brunk, past president of N.F.A., was honored at the Washington luncheon for his outstanding service during two years as association president. Left to right are: Paul L. Arnold, N.F.A. vice-president; W. W. C. Ball, president; Mr. Brunk; and A. V. Martens, past-president.

Aid Industrial Planning

Techniques of scientific analysis, borrowed from military tactical operations, are applied to industrial planning in a 62-page report just made available to industry by the Office of Technical Services. The report, prepared by Johns Hopkins University Operations Research Offices under contract with the Dept. of the Army, describes the functions of the operations analyst and his relations to the executive, the analytical tools used in operations research, and case histories. It includes a checklist for solving action problems, useful references, and a list of interested organizations. Order PB 111596 from Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C.; price: $1.75.

GET YOUR CASTINGS RIGHT IN THE GROOVE

with *fine* **FANNER**

DOUBLE HEAD GROOVESTEM CHAPLETS

finest chaplets ever developed to insure maximum fusion and core support because of these features . . .

1 FEATHEREDGE FUSION RINGS

Knife-like edges on the multiple rings heat instantaneously to fusion temperature — completely sealing chaplet into casting and eliminating leakers.

2 COMPLETE CONTACT RADIUS GROOVES

Molten metal rolls up solidly against the rounded bases of the radius grooves. Greater chaplet area contact results in maximum fusion. No sharp angles to trap gases or weaken stem strength.

3 COUNTERSUNK SHOULDERS

Heavy, tapered shoulders provide solid support to plates — allow full contact with molten metal. No sharp angles to create voids usually formed under heads of ordinary chaplets.

4 FULL STRENGTH

Reinforced construction at all required points provides maximum support without use of extra heavy metal.

5 TIN COATING

The surest protection against rust, as well as aid to fusion. Readily alloys with iron and steel, lowering melting point and improving fusion. Also available in pure copper.

6 PRECISION TOLERANCES

Held to ± .002 on most sizes, Fanner reputation for accuracy is unequalled.

BETTER CASTINGS because of

1. Assured core support
2. Maximum fusion
3. Freedom from leakers
4. Accurate wall thicknesses

• If you haven't investigated the advantages of fine FANNER Groovestem Chaplets for your work, by all means do so now. Foundries everywhere have found that this design has made a tremendous difference in the production of better quality castings because of its extra-strong core support and completeness of fusion. Firms doing critical casting work have confirmed its superiority by standardizing on Fanner Groovestem Chaplets. Get complete information by writing for samples and prices now!

Fanner Groovestem Doubleheed Chaplets are made in a variety of styles as shown, in sizes from 3/16" to 1½".

THE FANNER MANUFACTURING CO.

BROOKSIDE PARK CLEVELAND 9, OHIO

Designers and Manufacturers of Fine Fanner Chaplets and Chills

For more facts, circle No. 115 on postage-free Reader Service card on p. 103 or 104.

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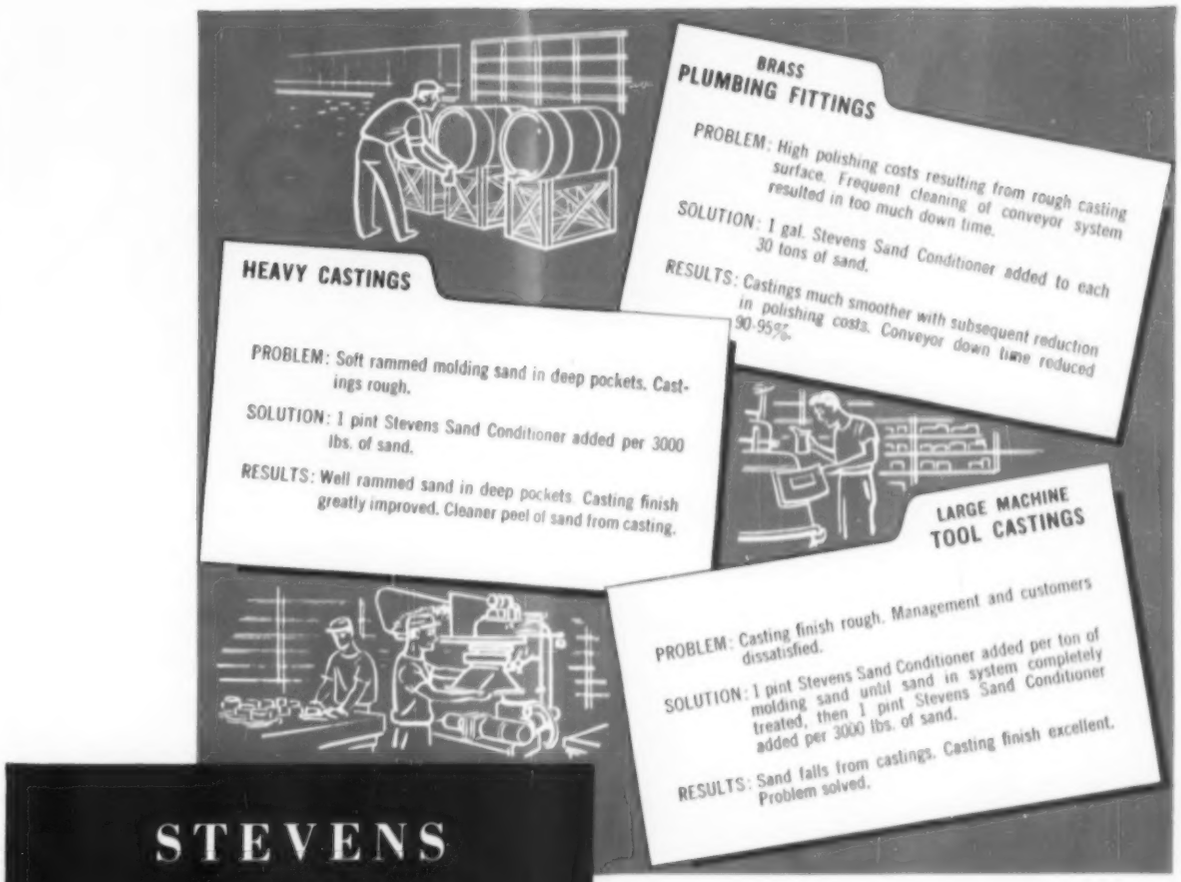
Foundries Earn Awards

Eleven foundries are among 68 Chicago-area plants awarded plaques for safe operations in the industrial injury prevention contest of the Greater Chicago Safety Council.

Among the winners were: Allied Steel Castings Co.; National Bearing Div., American Brake Shoe Co.; Burnside Steel Foundry Co.; Chicago Malleable Castings Co.; South Shops of Chicago Transit Authority; Crane Co.; Manufacturing Research, International Harvester Co.; Kensington Steel Co.; Linde Air Products Co.; Pullman-Standard Car Mfg. Co.; Pyle-National Co.; and Hawthorne Works, Western Electric Co.

Awards based on a comparison of the frequency and severity of accidents in 1954 and 1953 were presented at the banquet session of the 32nd Annual Midwest Safety and Fire Conference, May 3, at the Sherman Hotel, Chicago.

For more facts circle No. 76 on p. 103-104


BRASS PLUMBING FITTINGS
PROBLEM: High polishing costs resulting from rough casting surface. Frequent cleaning of conveyor system resulted in too much down time.
SOLUTION: 1 gal. Stevens Sand Conditioner added to each 30 tons of sand.
RESULTS: Castings much smoother with subsequent reduction in polishing costs. Conveyor down time reduced 90-95%.
HEAVY CASTINGS
PROBLEM: Soft rammed molding sand in deep pockets. Castings rough.
SOLUTION: 1 pint Stevens Sand Conditioner added per 3000 lbs. of sand.
RESULTS: Well rammed sand in deep pockets. Casting finish greatly improved. Cleaner peel of sand from casting.
LARGE MACHINE TOOL CASTINGS
PROBLEM: Casting finish rough. Management and customers dissatisfied.
SOLUTION: 1 pint Stevens Sand Conditioner added per ton of molding sand until sand in system completely treated, then 1 pint Stevens Sand Conditioner added per 3000 lbs. of sand.
RESULTS: Sand falls from castings. Casting finish excellent. Problem solved.

STEVENS SAND CONDITIONER

solves both mold and core production problems

These recent cases, taken from our files, show what Stevens Sand Conditioner has done to assure better castings for a few of the many satisfied Stevens customers. Here's how Stevens Sand Conditioner can help solve your core and mold production problems:

1. Increases flowability of core and molding sand to prevent soft rammed areas and pockets.
2. Cores draw easier from boxes, patterns draw easier from molding sand.
3. Improved casting finish on core and mold surfaces.
4. Sand peels better from castings.
5. Prevents sand from sticking in mullers, conveyors, hoppers and all sand handling equipment.

Get more facts about this non-toxic, low-cost Sand Conditioner today. Call your Stevens Sales Representative, or write direct for Stevens Technical Bulletin F 101. FREDERIC B. STEVENS, INC. Detroit 16, Mich.

FREDERIC B. STEVENS INCORPORATED
EVERYTHING FOR A FOUNDRY
DETROIT 16, MICHIGAN

BRANCHES: BUFFALO • CLEVELAND • INDIANAPOLIS • NEW HAVEN • DAYTON

STEVENS TARGET SALES SPECIALS FOR JULY AUGUST SEPTEMBER
STEVENS SAND CONDITIONER & LAUTHAN STRAINER CORE SHAPES
Write today or ask a STEVENS representative for details

Frederick B. Stevens, Inc., Congratulates MODERN CASTINGS on Its New Look

When you plan an electric furnace...

COMPARE COSTS PER TON OUTPUT

In these highly competitive times, we must be penny-wise *and* pound-for-pound-wise in figuring the costs of an electric furnace. Cost per ton of output is the wise way! So compute your costs by considering *all* factors! Here is why the Whiting Hydro-Arc Electric Furnace costs less *per ton of melt!*

(I) INSTALLED COST IS LESS because:

(1) the Whiting furnace foundation is simple
(2) it is completely assembled before shipment and shipped as fully assembled as practical
(3) cables are completely assembled
(4) all in-board wiring is finished and terminated at coded terminal blocks.

(II) OPERATING COST IS LESS because:

(5) electrode consumption is less
(6) electrode breakage is practically non-existent
(7) electrical energy usage for comparable operations is low
(8) top-charge, electrodes, furnace tilt and electrode clamps all operate quickly and efficiently
(9) transformer is designed to do the best job
(10) faster heats, more tons per hour

(III) MAINTENANCE COST IS LESS because:

(11) fewer working parts
(12) conveniently arranged working parts
(13) roofs are interchanged in 15 to 30 minutes
(14) refractory costs are at least 15 per cent less
(15) top-charge always in alignment
(16) all parts exposed to excessive heat are amply water-cooled
(17) smooth hydraulic operation of electrodes, furnace tilt, roof lift, and swing

So when you are buying an electric furnace, consider installation, operation and maintenance costs, quality of product and speed of operation. You'll find that Whiting melts *cost less*. Let us prove it to you. Talk things over with a Whiting Hydro-Arc Engineer!

Learn the Facts

Write today for Whiting Bulletin FY-168, which gives more complete information on how Whiting Features keep costs down, production up!

WHITING CORPORATION
15628 Lathrop Avenue, Harvey, Illinois

FEMA

modern castings *and* **American Foundryman**